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CHRONOLOGICAL LIST OF WITNESSES

APPENDIX

S. Hrg. 98-1018

AGRICULTURAL PRODUCTIVITY ACT OF 1983

HEARING

BEFORE THE

SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION

OF THE

COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

SECOND SESSION

ON

S. 1128

A BILL ENTITLED THE "AGRICULTURAL PRODUCTIVITY ACT OF 1983"

JUNE 14, 1984

Printed for the use of the
Committee on Agriculture, Nutrition, and Forestry

U.S. GOVERNMENT PRINTING OFFICE
9-015 O WASHINGTON : 1984

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AGRICULTURAL PRODUCTIVITY ACT OF 1983

THURSDAY, JUNE 14, 1984

U.S. SENATE,
SUBCOMMITTEE ON AGRICULTURAL RESEARCH
AND GENERAL LEGISLATION OF THE
COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:49 a.m., in room 328-A, Russell Senate Office Building, Hon. Thad Cochran presiding.

Present: Senators Cochran and Leahy.

STATEMENT OF HON. THAD COCHRAN, A U.S. SENATOR FROM MISSISSIPPI

Senator COCHRAN. The subcommittee will please come to order.

Today, this hearing is being conducted under the auspices of the Subcommittee on Agricultural Research and General Legislation. I am chairing the hearing temporarily. I understand the chairman of the full committee, Senator Helms, will be here later in the morning and will assume the responsibilities of the Chair.

We are looking this morning into a bill, S. 1128,[1] introduced by Senator Leahy and others. The Department of Agriculture is spending almost $19 million annually on research related to organic farming, and that is the general subject of the Productivity Act that is before the subcommittee. It seeks to explore, with an enlarged commitment from the Federal Government, alternatives to traditional farming practices and methods.

We have a statement from Senator Leahy which we will insert in the record.[1]

We also have a statement from Senator Huddleston which we will also include in the record.[1]

We are glad to have this morning as our leadoff witness Senator George Mitchell from the State of Maine.

We are honored to have you before the committee and we ask you to proceed in any manner you wish. Welcome.

STATEMENT OF HON. GEORGE MITCHELL, A U.S. SENATOR FROM MAINE

Senator MITCHELL. Thank you, Mr. Chairman. I appreciate the opportunity to appear this morning and offer testimony in support

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[1] See p. 118 for the prepared statement of Senator Leahy; p. 120 for the prepared statement of Senator Huddleston and p. 263 for a reprint of S. 1128.

of S. 1128, the Agricultural Productivity Act, introduced by Senator Leahy and cosponsored by 11 other Senators, including myself.

Mr. Chairman, I have a lengthy, detailed, prepared statement, attached to which are several additional statements to which I refer in my testimony. I would ask your consent that these statements be placed in the record. I will then simply present a very brief summary highlighting several points in my longer statement.

Senator COCHRAN. All of the material, including the statement, will be a part of the record.[1]

Senator MITCHELL. Mr. Chairman, I am here to convey to you the strong support which I have for this measure and which the measure enjoys among current and prospective organic farmers in the State of Maine. Many of them belong to an active organization, the Maine Organic Farmers & Gardeners Association, representatives of which with whom I meet from time to time.

The association has a legislative program, and S. 1128 occupies an important position on its agenda. When I learned that this subcommittee planned a hearing on this bill, I tried to arrive at a way in which Maine persons with knowledge and experience in the subject of organic farming could participate.

After providing a number of these persons with a copy of the bill and a copy of the administration's comments in opposition to it, I asked them to share with me their reaction to the bill and to the administration's arguments. I received from them a number of detailed letters, five of which I have included as attachments to my statement.

The letters reflect considerable thought on the part of the writers, and I am hopeful that they will be of assistance to the committee in its deliberations.

In summary, Maine's organic farmers believe that this legislation is long overdue, will lead to the conservation of soil and water resources, will result in the maintenance or increase of soil productivity, will increase farm output, and will initiate this effort with an authorization which would represent only a tiny portion of the Department of Agriculture's research budget.

Our Government must be more responsive to those farmers who desire to shift to organic farming systems. This bill would establish a modest, though meaningful, program which would constitute a first step in what must inevitably be a long, evolutionary process. I hope very much that the committee will consider and act favorably on this legislation.

I would like to note my thanks to the distinguished Senator from Vermont, Senator Leahy, for his leadership on this bill—another example of his foresight on agricultural matters and his dedication to assisting American farmers. I look forward to working further with him and you, Mr. Chairman, and other members of the committee in the effort to provide greater attention and assistance to what I believe will be beneficial to the future of this Nation's farms, and therefore to the future of this Nation—organic farming methods.

Senator COCHRAN. Thank you very much, Senator, for the excellent statement. Looking through the attachments and letters from

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[1] See pp. 121-137 for the prepared statement and additional material of Senator Mitchell.

your constituents in Maine, there is obviously a provocative argument to be made, an interesting argument, in behalf of more focus and direction to the research efforts that have been taking place in this area.

I am sure all of this will be very helpful to the committee, and we appreciate your taking time to be here this morning and be the leadoff witness.

Senator MITCHELL. Thank you, Mr. Chairman.

Senator COCHRAN. Thank you.

Our next witness on the agenda is the Honorable Orville Bentley, Assistant Secretary for Science and Education of the U.S. Department of Agriculture.

Mr. Bentley, come around. We appreciate your being here. We have a copy of your statement and we will make that a part of the record in its entirety, and ask you to make any summary comments or statements that you would care to make. You may proceed.[1]

STATEMENT OF HON. ORVILLE G. BENTLEY, ASSISTANT SECRETARY OF SCIENCE AND EDUCATION, U.S. DEPARTMENT OF AGRICULTURE

Dr. BENTLEY. Thank you, Senator. I am pleased to be here to present the testimony, and I know that you will make our statement a part of the record, so I would like to do this and then proceed, as you have invited me, to make some comments.

Our statement carries a number of important issues and I will take the time, if I may, to go over several of the major points in it. First, I would like to make a statement concerning the viewpoint of the Department of Agriculture relative to organic farming.

In the discussion of H.R. 2714, there has been considerable discussion about this topic and we have been asked to participate, and perhaps out of that has grown the impression that the Department of Agriculture is opposed to organic farming.

I want to make a statement very clear at the beginning that we are by no means opposed to organic or other alternative farming methods. ARS is presently spending some $18 million annually in support of research activities which will benefit organic farmers as well as the farmers who are looking for ways by which chemical inputs can be reduced.

We realize that we must consider the total productivity of our modern farming system and the use of various kinds of inputs, such as chemicals. We must recognize, too, that there are careful regulations, stringent regulations, that call for the proper use of these chemicals. But they have been important to the profitability of agriculture and the productivity of our American system of agricultural production.

So, as we talk about addressing this legislation today, we want to point out a few topics. The first is that there are a number of issues that need research that are interrelated and we must constantly update the technology and information that our Nation's farmers call upon us for and need in their production system. This

[1] See p. 139 for the prepared statement of Mr. Bentley.

applies to producers regardless of the farming system they may choose to use.

Likewise, we have a system of agriculturally supported research and extension education in this country that is unique. It is made up of a centrally focused program through the Federal research institutes, but there is cooperation of the independent, yet very responsive, State institutions engaged in research and extension education programs that attempt to address the needs of agriculture and of rural America. So this is a continuing part and it provides the setting in which we consider this issue.

I would like now to turn to comments about the system itself; that is, the research and education system. The Agricultural Research Service conducts research on problems that apply to regional and national scales. The work they do can apply to production and farms regardless of size, and the management system used, or other kinds of unique characteristics that we experience in this country.

State agricultural experiment stations are in the position, and do respond, to local, State, national and international needs in agriculture. They deal with subjects of food, soil, water, and other natural resources, plant and animal sciences, economic and social sciences.

In fact, the experiment stations provide an important linkage between the Federal and State components of our system. The understanding of the relationship between the parts of this system requires research on the biological and physical processes in the farming programs of this country.

Research must be conducted under a wide range of soil and water and climate and crop conditions to provide the basic data for applications of models or other analytic methods to specified production systems.

Thus, by focusing on individual components and interactions among them, research findings can be integrated into numerous production systems, whether they are organic or conventional, small or large, major commodities, or speciality crops. We think that this system has attempted to be interactive and involve both the State and the Federal scientists in these operations.

The Agricultural Research Service and the State agricultural experiment stations provide basic information for alternative or organic farming systems. For example, in the area of biocontrol of pests, researchers are finding natural biological enemies of insects, diseases, and weeds, and are developing ways to manage them to increase productivity.

Examples of research on biocontrol of insects include using microbial insecticides at the USDA insect pathology research unit at Brownsville, TX; coddling moth control by viruses by the University of California scientists; beet armyworm control research at Auburn; the use of fungi at the University of Georgia, the University of Illinois, and at other institutions.

We are also looking at the matter of conservation tillage, and cultural and management practices are being developed in various locations in the United States to deal with the issues that farmers are concerned with; that is, control of pests, the most efficient use of their soil resources, and so on.

There is another aspect of the research that is important when we consider this legislation, and that is to get research done on crop-rotation systems of production. It usually requires research being done at several locations and perhaps over several years.

Now, a good example of this experiment are the ones being conducted at the Lancaster Experiment Station in Wisconsin, and those have been in progress since 1967. These contain plot treatments needed for the comparisons of crop yields resulting from different cropping sequences.

The effects of these different cropping systems usually require several years to be expressed, and data of this type provide the basis for cropping system models and for farmer decisions as to the technologies they can adopt in their particular locations.

In another connection in our development of our research program, I am pleased to report that in April of this year the Agricultural Research Service stationed a scientist at the Rodale Research Center in Pennsylvania to provide liaison and to conduct research there that would reflect the collaboration between ARS and university scientists across the country.

This kind of a liaison will help answer some of the specific questions that have been raised in connection with alternative systems of farming, and also should add and strengthen our research programs wherever they are conducted, whether in experiment stations throughout the country or in our various locations in ARS.

The Extension Service has had a long history of providing information on the conservation of natural and nonrenewable resources, and on the protection of the environment in terms of our production systems.

That includes studies and programs in education having to do with variety, selection, adaptation of varieties to various climatic, and soil conditions, and management systems, and also includes the value of soil organic matter and its conservation or increase; pest monitoring and control and use of integrated pest-management systems; irrigation and water use to minimize environmental pollution; and other related activities.

We also are conducting educational programs having to do with gardening, and in these program publications there are topics such as composting, soil amendments, the use of manures, and other organic materials is stressed.

In these publications, though, we do include recognition of pest problems and the use of synthetic chemicals to control them. However, we have attempted to put these in separate factsheets so that we would not create confusion.

The National Agricultural Library provides information on alternative agriculture or organic farming for and through the Extension Service. Various bibliographic services provide information, pointing out the data bases that are available and the various vehicles that can be used to obtain additional information.

The library has informed me that there are 16 titles related directly to resource-conserving crop production systems, including double cropping and interplanting, composts, and composting of organic wastes, organic farming, and gardening, minimum/zero/conservation tillage, nitrogen fixation in soybeans, cropping systems, integrated pest management, crop rotation, and others.

One of the other reports I would like to make today is that we have looked at the research projects that are underway in the United States through the experiment stations and in ARS.

We have studied roughly 20,000 State and Federal projects for which there is fiscal year 1982 data, and we find that approximately 40 percent of them are relevant to farming systems research.

Of these, 85 percent are applicable to both organic, and alternate farming, and conventional farming systems, and 3 percent of them have a special applicability to organic farming.

The study will provide valuable information on many aspects of the agricultural production systems, and help the USDA and the States to better identify areas of needed research.

I would now like to turn to some specific comments concerning S. 1128. The enactment of the bill and the appropriation of authorized funding levels would exceed the President's budget request and would require Federal and State Extension Services to develop new programs that may be duplicative and unnecessarily costly.

Section 5 provides for 12 pilot projects on four different types of farms to examine the effects of a transition from use of synthetic or chemical systems to alternative nonchemical systems. The conditions of selection, the subsequent treatments, small sample size, and the omission of conventional systems makes the statistical base weak for needed comparisons.

The bill as written is restrictive, leaving the scientists and research managers, who are located where the research would be conducted, without flexibility to design the studies in ways to obtain the most meaningful results in responding to the objectives and the problem needs.

The specified timeframe of 5 years is much too short for the anticipated changes to be expressed. With the first year specified as the data base establishment year, only 4 remain for the measurement of effects. Then if a 4-year crop rotation is employed, for example, only one cycle would be completed and biased data could result. The bias would likely be unfavorable to the alternative farming system.

It must be recognized that the combinations of logical choices by farmers who might use either conventional or alternative farming systems are many. This complicates the research and the interpretation of the data.

Subsequently, unless the research utilizes sound statistical procedure, the application of conclusions to real-world conditions would be questionable. Problems of changing farming systems, however, can and are being researched in carefully planned interdisciplinary projects.

Let me emphasize that the research and extension education arms of the USDA and the cooperative State institutions are very concerned about the high cost of production faced by farmers. We are committed to continuing research and education activities to address the problems of all farmers.

To combine all the variables comprising a farming system in a research project is an imposing task, to say the least. Not only is it difficult and expensive, only one system of many possible options would be evaluated in each unit as described in the bill.

In summary, then, while we are sympathetic to the purposes of S. 1128, and supportive of organic farming research, we must remain opposed to the enactment of this legislation because of the restrictive requirements on the conduct of research, coupled with the fact that the USDA is already addressing the concerns set forth in this bill.

Mr. Chairman, we would also point out that the bill authorizes an expenditure of $10,500,000 to implement the provisions which it contains. This is a significant amount of money and the administration cannot, in good conscience, support such an increase in organic farming research.

Mr. Chairman, I am pleased to present this statement and we would be glad to respond to questions, if there are any. I have with me four people who are very well informed in this, and I would like to introduce them at this time.

Dr. Ed Knippling is the Associate Deputy Administrator for ARS and the national planning staff. Dr. Charles Smith is a soil scientist with the Cooperative State Research Service. Dr. Rick Gomez is a staff leader for plant and postmanagement sciences of the Extension Service. And Ms. Jane McLean is a reference librarian at the National Agricultural Library. They will be here to answer questions of a technical nature after the completion of the testimony.

Thank you, sir.

Senator COCHRAN. Thank you, Dr. Bentley, for being here and for the statement you have submitted to the subcommittee. There was one letter I noticed in the group attached to Senator Mitchell's testimony which complained about the lack of direction and focus of the research activities that are being undertaken at this time by the Department of Agriculture in the organic farming area.

What is your reaction to that suggestion?

Mr. BENTLEY. There is always a problem, of coordinating and getting information together in response to a specific question such as this, and I would admit that we can always do better.

However, I want to stress that Dr. Knippling and the group within the ARS, and Dr. Smith in CRS, are working hard to get the direction and get the coordination. I think the steps being taken by the ARS to designate a person to spend full time on this kind of cooperation and liaison will be helpful.

Likewise, the exchange of information through the Extension Service and through the National Agricultural Library are all steps being taken to coordinate and focus information. There is a focus on the issues that are involved in all kinds of farming systems because that is one of our major responsibilities.

Now, how it may be organized at a given time or in response to a given issue, may be one area in which we need to improve, and that is what we are committed to do.

Senator COCHRAN. Is there any one person or one office at the Department in charge of this research?

Mr. BENTLEY. No, there is not a single person in charge of the research, but there is a coordinating device; the national planning staff. Dr. Smith and Dr. Knippling would be the contacts and would help in conveying needs and developing recommendations.

In ARS, where there is a centralized funding program, they would come through the regular process, through Dr. Kinney and his staff.

Senator COCHRAN. With respect to the $18 million annually that is being spent in this research effort, could you break that down and tell us where the money is being spent in terms of which office is spending how much?

I am assuming from what you have said that all of it is not being spent by the Agricultural Research Service. Am I correct in that assumption?

Mr. BENTLEY. No, sir; the $18 million we referred to is being spent in the Agricultural Research Service itself.

Senator COCHRAN. I see.

Mr. BENTLEY. That is what we are speaking about, and we supply for the record the locations and amounts where these are expended.

Senator COCHRAN. You were not including in that the cost of books in the National Agricultural Library or any of these other things you mentioned, is that right?

Mr. BENTLEY. No. These are expenditures, for example, on horticultural crops and insect control—the portion of that expenditure by ARS that is directly related to farming systems.

Senator COCHRAN. If you could tell me, how much of the total effort is being focused on alternatives to chemicals? There is some suggestion here that that is being ignored.

Mr. BENTLEY. I will have to ask my colleagues to give a figure, but let me say that one of the important research areas that we see in agriculture today is to deal with biocontrol of insects or diseases.

That is one of the reasons we are encouraging research developments in biotechnology, because that shows promise of using those kinds of techniques to find new answers and improve our capacity in biocontrol.

Before turning to my colleagues, I would say that we have to keep in mind that plant breeding systems, for generations and centuries, have been aimed at adapting plants to the environment, and part of the environment is coping with the disease and insect problem. Many of the wheat varieties are an example. Cotton is another one where we are looking at tolerance, disease resistance, and insect resistance. That is a form of biocontrol.

Senator COCHRAN. Sure, and this is Dr. Smith?

Mr. BENTLEY. This is Dr. Knippling.

Senator COCHRAN. Dr. Knippling.

Mr. BENTLEY. I do not know if Dr. Knippling can answer the question specifically at this time for that particular breakdown.

Dr. KNIPPLING. I have some generalized figures that I can give you. We are giving extreme emphasis on biological control techniques as an alternative to chemical pest control. Within ARS, we are spending approximately $10 million at this point, which I would say is approximately 15 percent of our program in pest control. This would be insect, disease, and weed control.

Also, our germplasm enhancement and breeding program—I would say essentially 50 percent of that effort is oriented toward

the goal of pest resistance so as to avoid or minimize the need for pesticides.

Senator COCHRAN. What about the alternative chemicals in the fertilizer area? Is there anything being done there, any research there, or is there any research needed? What is your reaction to that?

Mr. BENTLEY. There is research as part of plant breeding and crop management systems that deal with improving the efficiency of utilization of chemicals. Let us take nitrogen as an example. That is a costly input to farmers, and yet an essential input to agricultural production.

There are still questions about whether we can improve the efficiency of utilization of nitrogen. That is being looked at continually, both from the standpoint of plant selection and from cropping systems, and that is an item that the industry was very much concerned with. They are doing a lot of research on delayed reaction, et cetera, which is very useful.

In terms of basic research, one of the areas that has been under a great deal of study—for a long time—and it has been found to be a very difficult problem, is the matter of nitrogen fixation in nonleguminous plants; that is, looking at cereal crops and others to try to introduce the capacity of those plants to fixed nitrogen.

That is one of the basic research programs that is under our competitive-grants activity in the State agricultural experiment stations. It is also a part of the research program in the plant physiology of the Agricultural Research Service, and a very exciting and challenging area, but a very difficult one. It it is an area that will continue to be studied in great detail.

Senator COCHRAN. I am going to have to step across the hall to visit with someone in my office, so I am going to ask Senator Leahy if he will assume responsibilities of the Chair while I am gone. I know he has questions and maybe other statements.

Senator LEAHY. Thank you, Mr. Chairman.

Senator COCHRAN. If you promise not to say anything bad about me, I will leave.

Senator LEAHY. I could not say anything but good about you, Mr. Chairman.

Senator COCHRAN. We work on this routine. [Laughter.]

[Senator Leahy assumed the chair.]

Senator LEAHY. Your testimony is interesting. Referring to your opposition to this, S. 1128 it is partly budgetary and I certainly commend you for wanting to save the taxpayers' money.

How much did the PIK Program cost last year?

[No response.]

Senator LEAHY. A figure of $12 billion comes to mind.

Mr. BENTLEY. The matter of the cost of the PIK Program—of course—is an area that I am not particularly directly involved in.

Senator LEAHY. Does $12 billion sound like a reasonable amount?

Mr. BENTLEY. I think $12 billion has been the cost that has been discussed.

Senator LEAHY. Nine or twelve. You see, back in my State the difference between 9 and 12 is——

Mr. BENTLEY. Substantial.

Senator LEAHY. Well, it is a wee bit. The difference between $9 and $12 billion is every single tax dollar collected in the State of Vermont over 6 years' time; that is the difference between 9 and 12.

The cost of the PIK Program last year was equal to all the taxes that will be collected from my State for the next 24 years. So, we tend to look at it as a big thing. Now, the cost of the organic farm legislation for 5 years is around $2.1 million. Is that 0.005 percent of the PIK Program? My math may be wrong, but it is 0.002 percent of the current Agricultural Research and Extension budget.

I do not want to break the bank with this program, of course, but are you sure that we cannot afford that 0.002? I mean, $2.1 million is still real money back home. Could it be possible, because $2.1 million is more in the grasp of the average person, that that is too expensive, and $12 billion for the PIK Program is not, or have I missed something in here?

I am just a smalltown lawyer, and I do not fully understand these things. Any help you can give me would be appreciated.

Mr. BENTLEY. Well, since we are comparing notes, I come from western South Dakota, so I know how much money and how little money States develop in terms of taxes.

Senator LEAHY. I am sure, yes.

Mr. BENTLEY. I am also aware that the decisions about farm programs are very complex ones, and the questions about PIK are issues that were discussed in great detail concerning farm programs and farm policy that is governed by a variety of committees, of which I am not a direct participant.

Senator LEAHY. I am not asking you to defend the PIK Program. I would not be that cruel to anybody. [Laughter.]

I just want to kind of keep the numbers in perspective; that is all.

Mr. BENTLEY. Let me then try to address the numbers. If you will allow me to express my bias in terms of science and education, the amount of money being expended by the agricultural industry—and I am not speaking now necessarily about the Federal budget or the State budgets—the collective expenditures are not as large as they should be in terms of the importance of the agricultural industry as a total. Therefore, I would say that is the problem.

The question, though, when it comes to this particular legislation, is that we feel we have research underway that is answering a lot of the questions being raised here. Therefore, to create a separate program of this type does raise questions of both the efficacy of getting the answers to the questions we have, and the expenditures of funds.

Senator LEAHY. I appreciate what has been done on it. I know that small parts of four staff people's time at USDA are devoted to organic work, so we are getting 80 percent of a full-time staffer. I am not sure which 80 percent we are getting, but I am sure if it is a hard-working person, that is something.

I remember in 1977 we requested a report on organic farming. In 1980, USDA produced a report and recommendations on organic farming. In October 1980 and again in 1981, the National Research and Extension Users Advisory Board recommended that USDA initiate organic systems research.

The USDA Agricultural Research Service, in 1983, advocated a similar study, but none has come. I realize everybody has to set priorities, and we might do you a favor by helping to initiate the recommendations that have been made.

Now, I realize that the kinds of things we are talking about may look like it is the concern simply of small farms, and small farms seem to be not all that important in the scheme of things anymore, which I think is unfortunate.

I happen to disagree with those who feel—and I am not suggesting you feel that way—that small farms do not count.

Really, all we are asking to do is establish 12 on-farm pilot projects—the kind of thing that an average farmer could not do. We are going to do it over a 5-year period, spread them around the country in diverse soil and climate conditions.

Why not take a chance? Why not do it and see what comes of it? I mean, I know you try to run a tight ship down there at USDA, but is it not conceivable that $2.1 million may have slipped through the cracks on less worthwhile projects at some time or another?

I mean, I am not talking about during this administration, of course, but possibly prior administrations.

Mr. BENTLEY. The obvious answer to that question is, I suppose, it is true that there have been slippages in expenditures of funds. But I guess I have to come back to the question about what are the problems, and whether a demonstration of the use of organic materials in cropping is necessary. After all, we have used organic manures and manures of various kinds in crop production for a long time.

It is a matter of answering specific questions that come up with regard to all kinds of things, and we think that we are approaching and finding information, and getting that information out to producers and the people that are interested.

Maybe we are not doing all the things we could do or should do or would like to do, but I think that we should not place the argument solely on whether we should spend $2.1 million and whether this will bring benefits. We are of the opinion that there are alternative ways of getting that information. We are trying to get that information, and that is what we are advocating in our position.

There have been other kinds of demonstration farms over the years, and some have helped and some have not been as effective. We do know that in the cropping sequences, if you go into rotations, and so forth, it takes more time.

As I say, in the case of the experiments in Wisconsin, they have been going on now for several years, and I hope we can continue them. Part of the reason we did these experiments was to get some of this information.

Now, it is a judgment, and I realize that. I will not make a dogmatic statement.

Senator LEAHY. I understand that not all programs are unqualified successes like the PIK Program. I think I heard on the radio the other day that of that $12 billion, the crop this year is expected to be affected by 1 percent. I do not recall whether it is going to be 1 percent greater or 1 percent less.

I read an article about them spending $400 for a hammer at the Department of Defense, and $2,000 or $3,000 for a stepladder. Why I should be thinking of that at the same time I heard about the 1 percent with the $12 billion—I have never quite made the connection, but I am sure there is some connection in there somewhere.

As I said, you know, when you are just a smalltown lawyer, you do not necessarily grasp these things immediately. But let me ask you a couple of more questions on this. You know, I see agriculture doing so well in the United States for three basic reasons.

One, I think that as a nation we are blessed with a lot of land across some of the most fertile growing areas in the world. Second, we have an indomitable spirit of our people. We were initially, after all, an agricultural nation.

But then, lastly, our agricultural research has been the best in the world; nobody has matched us. And to talk about 0.002 percent of the current agricultural research and extension budget and to say it is too much money to at least try—I cannot accept that. I cannot accept that especially when we are becoming so heavily energy intensive in our agriculture.

All anybody has to do is pick up the paper every morning and read the things that are happening in Iran and Iraq, and realize how volatile it is in the Middle East, one primary source of energy. We see other parts of the world where there is volatility in our energy sources.

You know, I share the average Vermonter's concern about money, and I do not say that facetiously. We are a very, very careful, cautious, conservative State. But I think we ought to take a little gamble on this one. I do not think it is much of a gamble.

Mr. Bentley. Let me point out, though, and stress something I have said. I accept the premise of not spending money on this. I have just been given some information as to the number of projects that are devoted to studies that are related to farming systems.

One of our budget requests and justifications for the Agricultural Research Service specifically looks at farming systems. Some 3,000 projects have been reviewed in terms of their relationship and have been identified as directed toward farming systems, and of those, just under 200 of them have special reference and significance to organic farming. The others apply to both systems of farming.

So we think that we are covering getting information like this. I might say that in my own experience at the University of Illinois, we initiated some courses and programs to try to answer questions that appeared to be unique to people concerned with organic farming, and that is being done in many States.

We are trying to answer some of the questions, so that is why we raised the issue here. When we take any given activity as a percentage of the total budgets, the numbers become difficult to follow through.

Senator Leahy. I understand.

Mr. Bentley. But we are committed to doing something here in this area.

Senator Leahy. Would that commitment be reflected in ARS Director Kinney's letter to Congressman Weaver, dated April 20, 1983, when he stated:

ARS did not spend any funding on organic systems research in fiscal years 1978 to 1983. The ARS six-year plan reflects zero dollar allocations for the fiscal year 1982 base period and projected for the period 1984-1990.

Does that reflect that commitment?

Mr. BENTLEY. But he goes on to point out that the research program areas that I have just referred to here are being covered; that is, in pest control, biocontrol, weed control, et cetera. The research being done under those particular definitions does apply to farming systems of all kinds, and part of them are specifically related to what might be termed "organic farming."

What he is referring to is specifically under the rubric of organic farming. But organic farming is made up of activities that have to do with supplying, for instance, nitrogen from the decomposition of organic matter or reducing the use of chemicals, the use of municipal wastes, and so forth, as sources of nitrogen or other nutrients; control of insects and diseases under different kinds of production systems. So I think that is the commitment we are talking about.

Senator LEAHY. Well, let us make sure I understand. USDA has four people who devote 20 percent of their time to organic research; then you have got the person assigned to work with the Rodale Farm. That is 1.8 full-time staff people working on organic research.

When Dr. Youngberg was working at USDA before you fired him in 1982, he worked half time and full time on organic research. So we went from 50 percent to 100 percent to 80 percent, to now 180 percent of full-time staffers on organic farming. Is that right?

Mr. BENTLEY. I might have to call on Dr. Knippling to answer the question on the specific people assigned to that, and I will do so. But our concern is that we are addressing organic farming questions as a part of our ongoing research program.

Senator LEAHY. With 1.8 people?

Mr. BENTLEY. No; with $18 million in support of organic systems, and that involves a number of topics.

Senator LEAHY. Would that involve an organic farming demonstration project?

Mr. BENTLEY. In ARS we would not have a demonstration project, per se. We would have field plots, though.

Senator LEAHY. Would USDA do a demonstration project?

Mr. BENTLEY. In our Agricultural Research Service we would not have what you would call field demonstration projects. Normally, it would be in research plots and test locations. Comparison plots would be more likely a part of the extension education activities carried out in each of the States.

If I may, sir, could I ask Dr. Knippling to comment on the specific assignment of people?

Senator LEAHY. Yes, and he may also want to comment on how he would feel if we took out of that $18 million the money needed for S. 1128.

Dr. KNIPPLING. I am not familiar with the exact staff years you quoted, but I think we prefer not to identify the research effort, per se, with scientists, but more to the staff man-years so that the staff persons have some functional responsibility related to the science of organic farming.

38-015 O—84——2

Senator LEAHY. They read the literature when it comes through and catalog it?

Dr. KNIPPLING. No; through program planning and future program direction, that type of thing. Staff persons, both within the Agricultural Research Service and CSRS, generally have specialties in biological control, plant breeding, soil fertility, soil management.

All of these functions are the scientific basis for organic farming or any type of farming system. Dr. Smith has been specifically assigned to the role of the lead coordinator for the Department for this alternative farming system.

Senator LEAHY. Well, I appreciate that. I may have some other questions for the record. I hope you do not mind my questions. You folks are the Washington experts and we folks from out in the sticks sometimes have to come in and ask these questions just so we can figure out what is going on.

Thank you very much.

Mr. BENTLEY. Thank you, and we will be glad to answer any questions.

Senator LEAHY. Sure.

Mr. BENTLEY. Senator Leahy, could I submit also for the record a letter to Congressman Skeen that deals with this particular subject? If I may, I would like to have that included.

Senator LEAHY. Of course. Thank you.

[The following letter was received by the subcommittee:]

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, DC, October 31, 1983.

Hon. JOE SKEEN,
House of Representatives,
Washington, DC.

DEAR CONGRESSMAN SKEEN: We have received your letter of October 28 regarding H.R. 2714, relating to organic farming.

As you know, the Department has opposed enactment of this legislation over the years. Is has been known in recent sessions as "The Organic Farming Act", the "Innovative Farming Act" and now as the "Agricultural Productivity Act". As it stands, HR. 2714 would authorize an expenditure of $10 million over a five-year period for additional research and "demonstration projects" on organic farming.

The Department has certainly had a long-standing interest in organic farming and other methods of alternative farming. We do not put "labels" on research. Therefore such research as minimum tillage or biological controls are not actually distinguished as "organic farming". Within the Agricultural Research Service (ARS) Six-Year Plan, we state clearly that we intend to continue the development of alternative systems within our overall program as a part of our general authorization. (Please refer to Page 61 of the attached "Agricultural Research Service Program Plan".)

The "authorities" granted in HR 2714 are not needed by USDA to carry out this type of research. Quite to the contrary, such specificity can actually be counter productive in that valuable on-going research might have to be set aside in favor of the Congressional-mandated program.

There is certainly no lack of information regarding organic farming. There are publications available from USDA, the State Cooperative Extension Services, State Colleges and Universities and the private sector. We have attached some of these publications for your information.

We would also add that these same sources are also involved in research and studies. For example, the University of Nebraska recently completed a study of organic farming in that state. A copy of this study is attached for your information and review.

The following USDA staff members will be in attendance at the mark-up session Tuesday morning for HR 2714; Ricardo Gomez, Extension Service, Clare Harris, Cooperative State Research Service and, Jerry Carlson, ARS.

We appreciate your interest in this matter.
Sincerely,

ORVILLE G. BENTLEY,
Assistant Secretary, Science and Education.

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, DC, January 20, 1984.

Hon. JOE SKEEN,
House of Representatives,
Washington, DC.

DEAR CONGRESSMAN SKEEN: This is in response to your letter of December 22, 1983, requesting additional information pertaining to activities related to H.R. 2714, the Agricultural Productivity Act of 1983.

With reference to your question about the Committee Report No. 98-587, page 22, which contains the Additional Views of Congressmen Bedell, Daschle, and Weaver, we supply this information. Prior to September 3, 1982, when Dr. Garth Youngberg received a specific reduction-in-force (RIF) notice that his position was being eliminated, he was assigned to the Science and Education Policy and Coordination Staff in a role one-half time (50%) as Organic Farming Coordinator, with the balance of his time being assigned to other responsibilities.

In September 1982, the responsibilities as coordinator and contact person for the Department of Agriculture's activities related to alternative or organic farming were assigned to Dr. Charles M. Smith, Soil Scientist, Cooperative State Research Service (CSRS). The following wording thereupon became a part of Dr. Smith's official job description: "Twenty percent of the incumbent's efforts will be devoted to alternative farming systems activities, variously labeled as organic and biological farming. Included in these efforts is the responsibility for providing a lead role for the Department and to serve as the Department's alternative farming systems point of contact. The incumbent will be responsible for maintaining a close liaison with the alternative farming researchers and specialists in the S&E agencies—Cooperative State Research Service, Agricultural Research Service, Extension Service, National Agricultural Library—and with appropriate scientists in State agricultural experiment stations and the Evans-Allen Institutions. In performing the lead role for the Department the incumbent will consult with appropriate officials in both action and research agencies as suitable to the needs of the Department. Guidance on alternative farming policy issues will be from the Assistant Secretary for Science and Education through the Administrator of the Cooperative State Research Service.

In addition, three persons in other Science and Education agencies were designated to work with Dr. Smith on these types of activities. They, likewise, have 20 percent of their job assignments on "organic farming" programs. This means that four persons, with a total of 0.8 FTE (full-time equivalent), have assigned responsibilities for these programs, whereas before the September 1982, there was one person at 0.5 FTE. The effect of having four people is a broader scope of contact between USDA and research and extension education individuals and programs. An additional important point to add is that many State and Federal researchers are working on problems directly applicable to organic farming systems. Some of these will be referred to later in this letter.

Those assigned to the alternative (organic) farming activities work with research and extension scientists and specialists in all States and USDA, as well as provide information as requested by anyone. Specific examples of their activities can be provided if you wish. However, Dr. C. I. Harris' testimony made reference to some of their activities, as does the Report, 98-587. Their names and agencies are:

Dr. Charles M. Smith, Soil Scientist, Cooperative State Research Service.
Dr. Ronald F. Follett, Soil Scientist, Agricultural Research Service.
Dr. Ricardo Gomez, Horticultural Program Leader, Extension Service.
Ms. Jayne MacLean, Librarian, National Agricultural Library.

You asked what investigations are underway to document research on farming systems, including organic farming. In September 1983, CSRS negotiated a Cooperative Agreement with the Iowa Agricultural Experiment Station at Iowa State University to engage scientists of the Agronomy Department to assess and classify all current research projects of the States and USDA that relate to farming systems, with particular emphasis on those projects producing results applicable to alternative or organic farming. This is explained on pages 24 and 25 of the Report on H.R.

2714, No. 98-587. Preliminary information indicates several hundred research projects apply to organic farming.

Alternative farming systems are defined differently depending on personal interests, experiences, and preferences. The Iowa study will identify those projects which fall within the scope of the definition in the 1980 USDA Report and Recommendations on Organic Farming. In addition, it is planned that other types of farming systems, when described, can also be identified with appropriate adequacy of research efforts being made on different segments of farming systems including those that constitute "organic" farming, thus helping to identify needed new thrusts.

In a letter addressed to Congressman Weaver, dated April 8, 1983, Dr. T. B. Kinney provided data to show ARS had $18.8 million, in FY 1982 invested in research that explored organic farming systems. This included insect control in horticultural crops and field crops, basic insect control technology, biocontrol and taxonomy, disease and nematode control, weed control technology, tillage practice, water use efficiency, and soil fertility.

"Organic" farming systems are not exclusively definable. In general, most of our contacts consider these types of systems as being those that stress maximum dependence on sources of plant nutrients from manures and other wastes, legumes, and plant residues, and on pest control from tillage, rotations, or biocontrol mechanisms. However the Integrated Pest Management (IPM) philosophy of using chemicals only when necessary is also accepted by many as being "organic."

Farming systems are a continuum formed by combinations of management options used by a farmer, that range from those using inputs that include no manufactured chemicals, to those that rely heavily on them. Evaluating these complex systems of farming is difficult and costly if data of acceptable precision are to be obtained. Small and often significant modifications in farming operations impart important differences in total and net returns to farmers. Therefore, there is no definite number of farming systems. However, there are groups of systems that have similar enough characteristics that useful research can be conducted, especially where analyses are made of combinations of farming practices that have had their component parts researched under adequately controlled conditions in order to produce reliable data.

Additional examples of ongoing research where results apply to "organic" farming systems, as well as to other systems include much work on nitrogen fixation by *Rhizobium* microorganisms in nodules in roots of legume plants. There are special efforts, such as those by State and ARS scientists at the University of Minnesota, where they are trying to increase the efficiency of this nitrogen fixing relationship so greater amounts of nitrogen can be "manufactured" by the plants in a shorter time span. This can result in less dependence on fertilizer nitrogen for succeeding corn crops. Also, there are Regional Research Projects in both the symbolic and nonsymbiotic nitrogen fixing areas of study. These include many States both where State and Federal scientists are working toward similar goals. Scientists are learning more about the mechanisms of fixation and factors causing higher efficiency with results being useful to farmers.

There are many examples given in the testimony of Dr. Clare I. Harris at hearings of both subcommittees that considered H.R. 2714. In addition in California there is a commercial "organically-grown" 12-acre apple orchard being studied for the influence of coddling moth control by virus. Other similar research is being conducted on pear and English walnut orchards.

It is recognized that "biological control" encompasses a large number of specialized areas including use of parasites, predators, pathogens and allelopathy, and ecological niche competition, among others. The State agricultural experiment stations had research effort on biological control in the amount of 90 Scientist Years and a total State and Federal (CSRS) budget of over $10.0 million, according to FY 1981 estimates.

Numerous additional examples can be given and more definitive information will be available on the completion of the studies at Iowa State University, and a comparable literature study at North Carolina State University, both arranged for by CSRS.

We trust this information provides the answers you were seeking. If we can be of further assistance please call on us.

Sincerely,

ORVILLE G. BENTLEY,
Assistant Secretary, Science & Education.

APRIL 20, 1983.

Hon. JIM WEAVER,
House of Representatives,
Washington, DC.

DEAR CONGRESSMAN WEAVER. Thank you for your letter of March 30 regarding organic farming research in the Agricultural Research Service (ARS). Our responses to your questions are numbered in the same order as cited in your letter.

1. There are no special authorizations existing now or needed for ARS to conduct research on organic farming. The general authorizations that cover all of our research activities are adquate.

2. ARS did not spend any funding for organic farming "systems" research in Fiscal Years 1975–1983. The ARS 6-Year Implementation Plan reflects zero dollar allocations for the Fiscal Year 1982 base period and projected for the period 1984 to 1990.

3. In an attachment to this letter, I am duplicating the list of 9 research areas and total ARS funds that you provided. For each of these areas, I have added the amount and percent of total funds that relate to organic systems research. Also included, as you requested, are statements on criteria on what types of research are classified as relating to organic farming systems.

4. ARS has not used or relied on any specific reports or analysis of organic farming for development of policies, redirections, or budgets pertaining to organic systems research. The ARS Program Plan and 6-Year Implementation Plan, with which you are already familiar, state in broad terms our program directions with respect to soil and crop research components that will be applicable to both organic and conventional farming, systems. Reference is also made to the USDA "Report and Recommendations on Organic Farming." A copy of this document is enclosed for your information.

We appreciate your interest in ARS research programs.

Sincerely,

T.B. KINNEY, Jr.,
Administrator.

Enclosure.

ARS RESEARCH FUNDS THAT SUPPORT ORGANIC FARMING SYSTEMS

[Dollars in thousands]

	Total	Support organic systems	Percent
1. Horticultural crops, insect control	$8,584	$1,716	20
2. Field crops, insect control	7,585	1,896	25
3. Basic insect control technology	12,768	1,300	10
4. Biocontrol and taxonomy	10,036	8,817	89
5. Diseases and nematodes control	9,766	525	5
6. Weed control technology	11,079	610	40
7. Tillage practices	3,489	1,400	40
8. Water use efficiency	9,254	700	7
9. Soil fertility	7,866	1,910	24

Criteria used to classify research components of insect-related research (items 1–A) as organic systems are studies which rely on such nonchemical means of insect management as insect-resistant plants and biological control.

Criteria used to classify research components of disease and nematodes control (item 5) as "organic systems" are: any study in which amounts, kinds, effects of, decomposition, and methods of application of any organic material—such as crop residues, municipal wastes, or innocuous industrial organic wastes—are determined on plant diseases or nematodes. Examples of research include; effect of sludge on plant disease, of crop residues on diseases, or of naturally high versus low organic soils on diseases and nematodes; efficacy of nematicides and effectiveness of biocontrol fungi which destroy parasitic crop fungi that live in various soil types; and effects of beneficial fungi such as mycorrhizas in various soils.

Critieria used to classify weed research (item 6) that supports organic systems include: (1) mulches for weed control, (2) reduced tillage practices, (3) crop residues on the surface in combination with selective herbicides and reduced tillage, and (4) crop rotations, cultural practices, and other ecological practices of weed control.

Criteria used that can provide useful results for organic systems for soil fertility, water-use efficiency, and tillage results (items 7–9) include research that addresses; mechanisms and prinicples whereby organic matter and residues improve water-use efficiency fro crop production; and mechanisms and principles whereby tillage practices enhance the maintenance of organic matter and sustained soil productivity, respectively.

Senator LEAHY. Thank you very much.

Mr. BENTLEY. Thank you.

(The following letter from Assistant Secretary Bentley with attachments, in response to questions from Senator Helms, was subsequently received by the subcommittee:)

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

AUG 15 1984

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Honorable Jesse Helms
United States Senate
Washington, D. C. 20510

Dear Senator Helms:

I appreciate the opportunity to provide additional information to the Committee hearing on S.1128, The Agricultural Productivity Act of 1983. The following responses are provided to your questions. If you want additional information, do not hesitate to ask.

Question: Please elaborate further on the $18.8 million the Department is spending on organic research? Is this an increase or decrease in expenditures for past research in this area and is this representative of the Department's overall research efforts?

Answer: The $18 million research support of organic farming referenced in my June 14, 1984, testimony is traceable to an exchange of correspondence in March and April 1983, between Dr. T. B. Kinney, Agricultural Research Service (ARS) Administrator and U. S. Representative Jim Weaver of Oregon, in which Mr. Weaver asked for Agricultural Research Service expenditures in several specific program areas. The $18 million figure refers specifically to ARS programs in biological efficiency of crops and non-chemical pest control, including development of pest-resistant plants, biological control, and basic insect control technology. Also included are programs in tillage practices, water use efficiency, and soil fertility. This figure is representative of the level of annual ARS research expenditures in these program areas over a period of several years. It does not represent all of the ARS research that can have application to organic farmers. Additional data are provided in the answer to question five pertaining to USDA funded relevant research by ARS and State Agricultural Experiment Stations.

Question: Recently the Department assigned a scientist from the Agricultural Research Service to the Rodale Research Center in a cooperative agreement between the Department and efforts in the private sector regarding organic agriculture. Please detail for the Committee the specifics of this venture and what benefits the Department expects.

Answer: The Agricultural Research Service established, effective April 15, 1984, a cooperative research program with the Rodale Research Center in Emmaus, Pennsylvania. The objective of the program is to obtain a scientific understanding of the interrelations between crop production, soil organic matter, and nutrient transformations in alternative farming systems. The cooperative arrangement includes the placement of an ARS soil scientist at Rodale for up to three years to work with Rodale scientists and to serve in a liaison capacity with a network of collaborating ARS and University or Agricultural Experiment Station scientists across the United States.

The collaborators will concentrate their research on specific crop and soil relationships, including nutrient cycling, soil biology, soil chemistry, and soil physics across a broad spectrum of farming system types, with the organic farming system represented by the Rodale Center being one point on this spectrum. Using computer technology, the ARS scientist at Rodale will assimilate data rising from these and other studies into simulation models as a basis for scientifically describing and understanding the biological interactions in farming systems and how to integrate farm practices for optimum crop production efficiency and resource conservation. USDA-ARS will fund the cooperative research program at the Rodale Research Center with approximately $80,000 annually.

Question: Proponents of S. 1128 have stated there is a lack of information from the Department on research and publications available on

organic farming. Could you provide the Committee with a bibliography concerning extension and research efforts on organic farming that is currently available.

Answer: Some examples of recent bibliographies developed by the National Agricultural Library NAL) on topics of current interest that apply to alternative farming systems were obtained from on-line searches of the AGRICOLA data base. Publications of the Quick Bibliography Series are intended for current awareness of recent investigations In add tion, their earches suppor ed the literature evaluation program of the Soil Science Department at North Carolina State University which is referred to in the answer to question six. Several examples of titles of the NAL series are listed below:

1. ORGANIC FARMING AND GARDENING
   1979-1984 — 137 CITATIONS
   1970-1983 — 274 CITATIONS

2. NONPOINT SOURCE POLLUTION: AN AGRICULTURAL CONCERN
   1981-1984
   126 CITATIONS

3. LEGUMES IN CROP ROTATIONS
   1970-1983
   143 CITATIONS

4. ALLELOPATHY: THE HARMFUL EFFECTS OF CHEMICALS PRODUCED BY ONE PLANT UPON ANOTHER
   1979-1982
   131 CITATIONS

5. DOUBLE CROPPING & INTER-PLANTING IN THE TEMPERATE ZONE
   1982-1983
   115 CITATIONS

6. MINIMUM/ZERO/CONSERVATION TILLAGE
   1979-1982
   270 CITATIONS

7. COMPOSTS AND COMPOSTING OF ORGANIC WASTES
   1980-1982
   98 CITATIONS

8. CROPPING SYSTEMS
   1970-1981
   255 CITATIONS

9. THE NEEM TREE (AZADIRACHTA INDICA); an Inhibitor of Insect Feeding & Growth
   1967-1981
   147 CITATIONS

10. INTEGRATED PEST MANAGEMENT
    1980-1983
    213 CITATIONS

11. EARTHWORMS; RAISING, USES, BENEFICIAL ASPECTS
    1978-1981
    97 CITATIONS

Question: Please detail for the Committee the coordination within USDA between administrators and researchers concerned with organic agriculture.

Answer: Four people with the Cooperative State Research Service (CSRS), the Agricultural Research Service (ARS), Extension Service (ES), and the National Agricultural Library (NAL) were designated about two years ago as the primary contact persons and to serve a coordination role. One of the four, Dr. Charles M. Smith, Soil Scientist of CSRS, was assigned the lead responsibility for the Department. He is frequently provided information by the three others who support and are knowledgeable of relevant research and education activities within their agencies. Other people are utilized as needed to accomplish the tasks of information, oversight, and coordination. In addition, a large number of USDA and State research and extension personnel actually conduct the relevant research and education programs, and coordinate or interact with others within their States and regions.

The contact/coordination persons respond to inquiries about relevant research and education activities of USDA, State Agricultural Experiment Stations, and State Cooperative Extension Services. They review new projects and publications, maintain liaison with those working in organic/alternative farming areas, assist in developing policy, provide guidance and management in the development of new thrusts in research and education, and perform other related tasks some of which are given in other parts of this letter.

An example is the interaction of State, Federal and private enterprise in setting up a network of scientists at the Rodale Research Center to facilitate an efficient and potentially productive approach to

alternative farming systems research as explained in question two. Also there has been much sharing in the development and implementation stages of other comprehensive efforts including the Iowa and North Carolina studies referred to in answers five and six. In each of these cases, USDA agency administrators have approved involvement of personnel and funds needed to accomplish the tasks of organization and implementation.

Question: Could you provide the Committee a further elaboration of organic farming studies being conducted at Iowa State?

Answer: In this comprehensive analysis, Iowa State University scientists reviewed about 9,000 research projects of State Agricultural Experiment Stations, ARS, and other USDA research performing agencies classified in the Current Research Information System (CRIS), and further classified 6413 projects in detail. Based on carefully defined criteria reviewed by State, ARS, CSRS, and Rodale Research Scientists, the research projects were classified as to whether they have relevance to organic or alternative farming systems, and as to the degree of such relevance. A complete report will be available in the early part of 1985.

There were three categories of research classification and expenditures as related to organic/alternative farming, including: <u>Total</u>, related to all farming systems; <u>neutral</u>, applicable to either conventional or organic/alternative farming systems; and <u>special</u>, having special application to organic/alternative systems, such as biocontrol of pests.

The <u>total</u> expenditure on farming systems research for FY 1982 was $574.7 million including State and other non-Federal and all Federal sources. Of this, $508.5 million was classified as <u>neutral</u> of which $24.4 million was labeled <u>special</u>.

Considering only the USDA appropriated funds, utilization in FY 1982 was as follows: ARS--$146.5 million <u>total</u>, $130.3 million as <u>neutral</u>, $8.2 million as <u>special</u>; CSRS/State Agricultural Experiment Stations--$89.2 million <u>total</u>, $79.1 million as <u>neutral</u>, $3.9 million as <u>special</u>. These data are not inconsistent with the answer to question one as the scope of the request was different.

This study contains much more information on field and horticultural crops, livestock production, resources management economics and other areas that will be very useful in planning future work on various types of problems related to conventional or alternative agricultural production systems. Further details will be available in the 1985 report.

Question: Please provide the Committee any data or information that is available from research efforts like the Iowa study, or any other efforts that would be useful to the Committee.

Answer: In September of 1982, the USDA-CSRS entered into a cooperative agreement with North Carolina State University to share with them the funding support and guidance to develop an evaluation and summary of published scientific research which would be relevant to organic farming. The task was begun by preparing a mutually agreed to outline of research areas considered of importance to organic farmers. These major areas included weed, insect, and disease control strategies without pesticides, providing plant nutrients by means other than through commercial fertilizers, soil organic matter and residue management under various tillage systems, the economics of organic farming, and the historical and philosophical research and writings of the organic movement. The search and characterization of readily available research information is being indexed relative to its direct or marginal applicability to organic farming systems. The final task of Phase I will be a subjective evaluation of the literature by research area as to its adequacy for providing answers to problems which face organic farmers.

A second phase of this study is proposed for the development of major review papers as indepth summaries of the state-of-knowledge as it applies to organic farming, its applicability and scientific validity, and to identify major voids and priority areas which would benefit by additional research. Although the review papers would summarize information most applicable to organic farmers, it is also hoped that it would identify and focus on agricultural principles and practices which would have a broader appeal and potential adoption by conventional farmers.

Question: You and other witnesses said the design and comparisons specified in S. 1128 for "transition", whole farm research, would not result in reliable data for use by other farmers. If the bill were to specify whole farm comparisons utilizing minimum inputs of high energy-high cost chemicals, but omitted the procedural details of Section 5 and left such matters up to the research scientists to develop such designs, do you believe appropriate research procedures could be developed and that useful and applicable results would result?

Answer: Yes, procedures could be developed with the expectation that the results could be extended to other similar farming conditions. Comparisons among farming systems and farms are difficult to accomplish with acceptable precision because of the large amount of variability in soils topography past and current crop and soil management, and climate. Procedures of research including the needed comparisons and techniques of data collection and analysis, would be developed and adapted as needed to the kinds of variability encountered in the different research settings.

Question: Supporters of S. 1128 are calling for research on "organic farming systems." Could you tell this Committee what the Department is already doing in this area and if more needs to be done?

Answer: ARS has conducted considerable research on the broader spectrum of agricultural systems including the full array of conservation tillage practices for optimizing productivity and resource conservation. However, prior to the recent establishment of the ARS scientist position at the Rodale Research Center, ARS has not conducted research specifically directed toward organic farming systems per se.

The State/CSRS partnership has produced a significant amount of research on cropping and management systems, rotations, use of legumes, manures, and other inputs of specific interest to organic farmers. There have been studies conducted by agricultural economists where systems have been compared. However, the number of comparisons specifically involving organic farming systems as described in S. 1128 is limited.

Question: You said the length of time (5 years) specified in the bill is too short. What time-horizon would you use? And, with your indication of more years needed to obtain reliable results, how can researchers obtain information needed for education (Extension) use in a shorter time?

Answer: The time required for definitive results from research on alternative farming systems would be a minimum of two cycles of the crop being tested after collection of base data for 2 or more crop years, or a total of 10 to 12 years minimum. The long time is needed to objectively reflect differences in climate and management decisions as they impact yield and net return of the farmer. Then, further research will be needed to reflect changes in technologies and in other factors over time.

Well designed research of this type, will yield valuable information in a shorter time frame on problems associated with changing systems such as weed control, nutrient cycling, timing and sequence of operations, effects of certain crops and management practices on residues and properties of the soil surface, etc. Researchers can also obtain valuable information in the interim time period through simulation modeling of agricultural systems and indepth fundamental studies of the biological and physical processes that make up the components of such production systems.

Question: The Department of Agriculture referred to crop rotation experiments at Lancaster, Wisconsin as being appropriately designed and conducted to generate much useful information for "organic" or alternative farming system agricultural producers. Do you believe this could be used in analyses of whole farm comparisons, if such were justified?

Answer: Yes, the data obtained each year from this experiment and others like it are excellent base information for alternative farming systems evaluations. This continuing experiment conducted by scientists from Illinois, Iowa, Minnesota, and Wisconsin has had certain variables under study since 1967, with modifications in 1977. Comparisons of crops, sequences, crop-entry position in a rotation, zero fertilizer rates, and first-, second-, and third-year corn allow numerous economic

interpretations, along with evaluation of variable soil conditions.

Copies of the 1983 summary and complete reports are enclosed for your information. These data will be useful in simulation modeling as well as for direct comparisons.

Question: One witness said little is being done by researchers in USDA (and States, implied) on integrated production systems, such as IPM (Integrate Pest Management). Do you agree?

Answer: We do not agree with this statement. In ARS, $10.1 million is directed toward integrated pest management research. Research on integrated agricultural production and conservation systems amounts to $5.0 million.

In addition there are major and effective programs on IPM in the State Extension Services and the State Agricultural Experiment Stations. The National IPM Coordinating Committee, an interdisciplinary, interagency, and Federal/State group, has developed a plan entitled, "National Plan for IPM: Research, Education and Technology Transfer," dated February 27, 1984. This plan details the objectives, history of programs, funding, and other aspects of current programs. A copy is enclosed for your information.

Question: If additional money is authorized in this area, what suggestions for use of this money do you have that will provide us new and innovative research?

Answer: Additional funds would be directed toward integrated agricultural systems, including assimilation and integration of biological and physical research data into systems of analyzing complex interactions of two or more research areas.

Research would also be directed toward using new computer technology to develop and validate predictive models for similating the interrelationships of physical and biological factors on agricultural productivity and environmental quality as related to farming systems.

Innovative techniques for assessing the behavior of highly variable fields and farms, rather than the traditional experiment test plots, must be perfected and tested for systems comparisons. As contrasted with small plot research, the variability across and among fields and in year-to-year measurements requires nontraditional sampling and analytical techniques. Concurrently with studies of alternative integrated production systems, evaluation of geostatistical and other nonclassical statistical methods will result in more useful methodologies. Other potentially productive innovative approaches could be described if such is desired.

Question: Some processors of municipal wastes are advising that such products not be used on food crops because of the levels of heavy metals in such wastes. Could you comment on this, and would much of the processed municipal wastes be limited to nonfood crops such as park grounds and flower beds?

Answer: It is true that some municipal wastes, depending on their source and degree of treatment, contain hazardous or potentially hazardous concentrations of heavy metals and other contaminants such as pathogens. In addition to uses on park grounds and flower beds, they could be used, with proper management and some other precautions, on nonedible (fiber) or processed crops such as sugarbeets and sugarcane. Also, in some limited cases, municipal wastes could be used on certain food crops such as the cereal grains in which heavy metals accumulate in the plant foliage rather that in harvested seed.

Question: Please elaborate for the Committee your efforts in biocontrol and biotechnology and how these efforts will impact agriculture.

Answer: Research conducted by ARS and through CSRS administered funds at cooperating State institutions has shown that beneficial pathogens, predators, and parasites have great potential for controlling insects, diseases, nematodes, and weeds in a variety of agricultural production systems. The successful development of these technologies will provide an important alternative to the use of chemical pesticides.

Currently, ARS is expending $4.9 million for biological control research. Of the CSRS appropriated funds for FY 82, $3.5 million were expended by the cooperating State institutions. In addition, these State research institutions used $1.0 million of other USDA appropriated funds, $1.48 million from non-USDA Federal sources, and $12.98 million of State and other non-Federal funds.

There is a strong biological control component in the Integrated Pest Management (IPM) programs conducted by Extension Services in all States. These programs allow implementation of biological control measures in concert with pesticidal, cultural and other control methods. Examples of successful and ongoing educational IPM programs with very strong and visible biological control components include those on floricultural crops in Florida, weeds in Missouri and soybeans in Maryland and Virginia. We estimate that at least 25% of the Extension IPM effort could be identified as biological control.

To provide other alternatives, significant biotechnology research by both State and Federal scientists is directed toward development of crop genetic resistance to pests, increased effectiveness of biological control organisms, improved biological nitrogen fixation, and improved efficiency of soil and root microorganisms that make soil nutrients available to crops.

Including current data from the Iowa study, referred to in question five, resulted in a delay in our response. I trust this has caused you no inconvenience. If we can be of further assistance, do not hesitate to call on us.

Sincerely,

Orville G. Bentley
ORVILLE G. BENTLEY
Assistant Secretary
Science and Education

Enclosures

1977-83 CROP SEQUENCE EXPERIMENT PROGRESS REPORT
(Illinois, Iowa, Minnesota and Wisconsin)
(Seven Years of a Modified Crop Sequence Study Based Upon a Previous Ten Year Crop Sequence Study Conducted 1967-76.)

Cooperating Researchers: Dr. Walt Wedin (ISU)
Dr. Rick Cruse (ISU)
Dr. John Webb (ISU)
Dr. Don Graffis (UI)
Dr. Joe Jackobs (UI)
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Dr. William Paulson (UW)
Dr. Roger Higgs (UW)

Six different rotations: continuous corn, continuous meadow, CSbCOM, CCOMM, CCCMM and CCMM were compared in 1977-83 at the Lancaster Experiment Station in Southwestern Wisconsin. Nitrogen was applied to corn in the rotations at rates of 0, 50, 100 and 200 pounds per acre. The 1977-83 plots were either continuations or alterations of plots utilized in a ten-year crop sequence study conducted from 1967 to 1976. The continuous corn, CSbCOM and CCOMM sequences are the same as the previous ten-year study. The continuous meadow, CCCMM and CCMM are new sequences which were begun in 1977. The first year meadow is directly seeded without a companion crop in the CCCMM and CCMM rotations. The continuous meadow treatment was reseeded (direct seeded) in 1980 because of a reduced alfalfa stand. The reseeded stands were excellent in the continuous meadow plots in 1981-83. Tables 1-4 provide yield results and an analysis of variance for 1983 for corn, oats, alfalfa, and soybeans. Tables 5-8 provide seven year yield results for the four crops. Table 9 provides a seven year (1977-83) analysis of varience for four crops. Tables 10 and 11 show weather and cultural information for 1983.

The 1983 growing season was characterized as hot and dry for June, July, and August and the stress significantly reduced crop yields. The heat unit accumulation was below normal in May, but above normal in June through September. Precipitation was below normal by nearly four inches total in June through August.

The average yield of corn in 1983 were 33.1 bushels below the seven-year average. Soybeans and alfalfa hay were below the seven year average in 1983 by 10.5 bushels and 0.4 tons, respectively. Oats, however, were 12.9 bushels above average in yield and unlike the other crops because the stress affected later maturing crops and later harvest dates.

In 1983, corn yields were significantly different among the 0, 50, 100, and 200 pounds per acre nitrogen levels with an average yield of 71.1, 92.6, 95.7 and 99.9 bushels per acre, respectively. Nitrogen application provided

appreciable yield increases for second year corn, third year corn and continuous corn in most rotations. The analysis of variance for 1977-83 corn yields showed significant differences among nitrogen levels, among years, and among rotation phases and sequences.

The 1977-83 oats yields were significantly benefited by the residual nitrogen carried over in the soil from the previous corn crops in the CSbCOM and CCOMM rotations. The seven year comparison of oats grown where no nitrogen was applied the previous year with the 200 pounds per acre nitrogen showed a yield increase of 30.2 and 20.4 bushels per acre due to nitrogen for the two rotations. There was also a significant difference between crop sequences and among years for the seven year analysis of variance.

The 1977-83 soybean yields were benefited 2.3 bushels per acre by the residual nitrogen carried over in the soil by applications of 100 or 200 pounds per acre to previous corn, but this difference was not significant, statistically. As was similar for corn and oats, the year effect was significant.

The hay yields were very similar for the different nitrogen levels for 1977-83 and there was not a significant difference, statistically. Alfalfa hay yields averaged 3.16 tons per acre in 1983 as compared with 3.55 tons of dry matter per acre as an average for 1977-83. Two average cuttings and one poor cutting were obtained in 1983. The third cutting was severely reduced because of the hot and dry weather. Direct seeded alfalfa yielded 1.4 tons in 1983, 1.6 tons in 1982, 2.1 tons in 1981, 2.3 tons in 1980, 1.6 tons in 1979, 1.5 tons per acre in 1978 and 2.9 tons per acre in 1977. Thus, the 1983 yield per acre of 1.4 tons per acre was 0.5 tons below the seven year average of 1.9 tons per acre of direct seeded alfalfa.

The second year of hay in the COMM and CCOMM rotations was the highest yielding year within these hay rotations for the seven year average 1977-83. For example, the second year hay in COMM and CCOMM yielded 4.37 and 4.35 tons per acre for a seven year average. The second year of hay in the CCOMM rotation yielded 0.40 tons per acre more than the first year of hay in the CCOMM rotation.

The first year direct seeded alfalfa in the CCCMM rotation and to a lesser extent in the CCMM rotation yielded higher at the 200 pound level of residual nitrogen than at the lower levels of residual nitrogen.

Additional information was reported in 1981 regarding the yield of alfalfa after oats had been harvested. Tonnage yields of 0.71 and 0.76 per acre were obtained for the CSbCOM and CCOMM rotations, respectively in 1981. This information was not obtained in 1982 or 1983 because of slow hay growth.

Tables 12-15 provide ten year yield averages for 1967-76 and compares these with 1977-83 seven year yield averages. Some crop sequences were changed prior to the 1977 year, therefore comparisons are not available in some cases.

An analysis of variance was computed for 1977-83 and 1983 for each crop.

A paper regarding the 1967-76 data from this study was published in 1981 in the Agronomy Journal. The paper was entitled: "Legumes and Mineral N Effects on Crop Yields in Several Crop Sequences in the Upper Mississippi Valley".

Table 1. Corn yields (bushels/acre adjusted to 15.5% moisture) and analysis of variance in crop sequence study at Lancaster Wisconsin

Crop Sequence	Plot	Rep	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
Cont corn	1	1	24.8	76.2	77.1	91.5	67.4
		2	20.9	56.2	86.2	92.3	63.9
		Ave.	22.9	66.2	81.7	91.9	65.7
CSbCOM	4	1	85.4	110.6	116.7	102.4	103.8
		2	71.9	110.6	104.5	106.3	98.3
		Ave.	78.7	110.6	110.6	104.4	101.1
CSbCOM	6	1	91.9	97.6	91.0	108.5	97.3
		2	71.4	92.8	88.9	99.8	88.2
		Ave.	81.7	95.2	90.0	104.2	92.8
CCOMM	10	1	106.3	92.8	92.8	108.0	100.0
		2	63.3	84.5	108.0	102.8	89.7
		Ave.	84.8	88.7	100.4	105.4	94.8
CCOMM	9	1	60.5	76.7	84.5	106.7	82.1
		2	42.3	72.7	101.5	96.7	78.3
		Ave.	51.4	74.7	93.0	101.7	80.2
CCOMM	11	1	55.3	94.1	91.5	91.5	83.1
		2	70.6	81.9	85.4	79.7	79.4
		Ave.	63.0	88.0	88.5	85.6	81.3
CCOMM	14	1	105.9	106.7	107.2	113.7	108.4
		2	93.7	80.6	81.9	102.4	89.7
		Ave.	99.8	93.7	94.6	108.1	99.1
CCOMM	15	1	68.0	81.9	87.6	98.9	84.1
		2	49.7	106.3	86.2	96.7	84.7
		Ave.	58.9	94.1	86.9	97.8	84.4
CCMM	21	1	99.8	105.0	91.0	88.4	96.1
		2	105.0	130.2	122.0	101.1	114.6
		Ave.	102.4	117.6	106.5	94.8	105.4
CCMM	18	1	87.6	108.0	108.5	112.4	104.1
		2	47.5	86.2	101.5	97.1	83.1
		Ave.	67.6	97.1	105.0	104.8	93.6
1983 Average			71.1	92.6	95.7	99.9	89.8

Table 1. (Continued)

Analysis of Variance of corn yields for 1983

Source	d.f.	m.s.	F	Significance
Replication	1	636.76	2.66	NS
Phase/Sequence	9	1135.80	4.75	*
Nitrogen level	3	3290.03	39.40	**
Phase x Nitrogen	27	244.74	2.93	**

*, **, NS refers to 0.05 and 0.01 probability levels and nonsignificance, respectively.

Table 2. Oats yields (bushels/acre) and analysis of variance for the 1983 crop sequence study at Lancaster, Wisconsin

Crop Sequence	Plot	Rep.	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
CSbCOM	2	1	60.0	62.8	66.9	72.7	65.6
		2	44.5	43.0	74.6	72.8	58.7
		Ave.	52.3	52.9	70.8	72.8	62.2
CCOM	16	1	61.4	84.3	80.0	84.1	77.5
		2	64.2	71.7	71.6	100.1	76.9
		Ave.	62.8	78.0	75.8	92.1	77.2
1983 Average			57.6	65.5	73.3	82.5	69.7

Analysis of Variance of oats yields for 1983

Source	d.f.	m.s.	F	Significance
Replication	1	55.13	1.38	NS
Sequence	1	901.50	22.53	NS
Nitrogen level	3	454.66	7.39	NS
Sequence x Nitrogen	3	79.91	1.30	NS

NS refers to nonsignificance.

Table 3. Soybean yields (bushels/acre) and analysis of variance for 1983 crop sequence study at Lancaster, Wisconsin

Crop Sequence	Plot	Rep.	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
CSbCOM		1	30.0	31.2	24.9	25.9	28.0
		2	34.7	32.6	30.8	33.9	33.0
		Ave.	32.4	31.7	27.9	29.9	30.5

Analysis of Variance of soybean yields for 1983

Source	d.f.	m.s.	F	Significance
Replication	1	50.00	13.12	*
Nitrogen level	3	8.51	2.23	NS

*, **, NS refers to 0.05 and 0.01 probability levels and nonsignificance, respectively.

Table 4. Alfalfa hay (meadow) yields (tons/acre dry matter) and analysis of variance in 1983 crop sequence study at Lancaster, Wisconsin[a]

Crop Sequence	Plot	Rep.	Nitrogen level - applied to corn (lbs/acre)[b] 0	50	100	200	Average
CSbCOM	3	1	2.01	2.82	2.27	2.12	2.31
		2	4.31	4.04	3.95	4.01	4.08
		Ave.	3.16	3.43	3.11	3.07	3.19
CCCMM	7	1	1.43	1.49	1.14	1.24	1.32
		2	1.35	1.49	1.06	1.24	1.29
		Ave.	1.39	1.49	1.10	1.24	1.31
CCCMM	8	1	3.70	3.96	3.66	3.70	3.76
		2	4.59	3.87	4.37	4.49	4.33
		Ave.	4.15	3.92	4.02	4.10	4.05
CCOMM	12	1	2.99	3.12	2.70	1.99	2.70
		2	3.99	3.47	2.54	3.68	3.42
		Ave.	3.49	3.30	2.62	2.84	3.06
CCOMM	13	1	4.00	4.23	4.03	4.29	4.14
		2	4.26	4.55	4.69	4.47	4.49
		Ave.	4.13	4.39	4.36	4.38	4.32
CCMM	19	1	1.65	1.17	1.66	1.08	1.39
		2	1.47	1.26	1.78	1.54	1.51
		Ave.	1.56	1.22	1.72	1.31	1.45
CCMM	17	1	3.61	3.74	3.89	4.00	3.81
		2	4.14	3.48	3.83	3.88	3.83
		Ave.	3.88	3.61	3.86	3.94	3.82
Cont meadow	20	1	4.04	3.77	4.26	3.73	3.95
		2	4.39	4.29	4.37	3.87	4.23
		Ave.	4.22	4.03	4.32	3.80	4.09
1983 Average			3.25	3.17	3.14	3.09	3.16

Analysis of Variance of alfalfa yields for 1983

Source	d.f.	m.s.	F	Significance
Replication	1	3.624	5.280	NS
Phase/Sequence	7	11.185	16.300	**
Nitrogen level	3	.074	.980	NS
Phase x Nitrogen	21	.095	1.263	NS

[a]Harvested June 6, July 11, and August 22. Plots 7 and 19 were not harvested on June 6 because they were direct seeded in 1983. The direct seeded plots were harvested July 11 and August 22.

[b]Nitrogen was applied only to corn in the rotation.

*, **, NS refers to 0.05 and 0.01 probablity levels and nonsignificance, respectively.

Table 5. Corn yields (bushels/acre adjusted to 15.5% moisture) for the seven year averages for 1977-83 crop sequence study at Lancaster Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
Cont corn	Ave. Six Year 77-82	36.8	87.0	107.2	132.4	91.0
	1983	22.9	66.2	81.7	91.9	65.7
	(77-83)Seven Year Ave.	34.8	84.0	103.6	126.6	87.3
CSbCOM	Ave. Six Year 77-82	121.9	125.7	130.9	132.0	127.6
	1983	78.7	110.6	110.6	104.4	101.1
	(77-83)Seven Year Ave.	115.7	123.5	128.0	128.0	123.8
CSbCOM	Ave. Six Year 77-82	126.1	135.7	143.5	134.8	135.1
	1983	81.7	95.2	90.0	104.2	92.8
	(77-83)Seven Year Ave.	119.7	129.9	135.9	130.4	129.0
CCCMM	Ave. Six Year 77-82	137.9	138.2	147.0	137.3	140.2
	1983	84.8	88.7	100.4	105.4	94.8
	(77-83)Seven Year Ave.	130.3	131.1	140.3	132.7	133.7
CCCMM	Ave. Six Year 77-82	99.9	123.2	137.0	135.1	124.0
	1983	51.4	74.7	93.0	101.7	80.2
	(77-83)Seven Year Ave.	93.0	116.3	130.7	130.3	117.6
CCCMM	Ave. Six Year 77-82	79.9	119.7	130.7	134.3	116.2
	1983	63.0	88.0	88.5	85.6	81.3
	(77-83)Seven Year Ave.	77.5	115.2	124.7	127.3	111.2
CCOMM	Ave. Six Year 77-82	133.4	143.1	143.6	139.2	139.8
	1983	99.8	93.7	94.6	108.1	99.1
	(77-83)Seven Year Ave.	128.6	136.0	136.6	134.8	134.0
CCOMM	Ave. Six Year 77-82	112.1	131.2	143.4	139.7	131.7
	1983	58.9	94.1	86.9	97.8	84.4
	(77-83)Seven Year Ave.	104.5	125.9	135.3	133.7	124.9
CCMM	Ave. Six Year 77-82	142.0	144.6	146.2	138.4	142.8
	1983	102.4	117.6	106.5	94.8	105.4
	(77-83)Seven Year Ave.	136.3	140.7	140.5	132.2	137.4
CCMM	Ave. Six Year 77-82	119.7	130.9	145.9	142.4	134.7
	1983	67.6	97.1	105.0	104.8	93.6
	(77-83)Seven Year Ave.	112.3	126.1	140.1	137.0	128.8
	1977 Average	88.0	97.7	102.3	96.9	96.3
	1978 Average	120.6	134.4	146.2	135.7	134.3
	1979 Average	128.0	136.6	147.6	155.5	141.9
	1980 Average	101.2	118.2	123.9	127.7	117.8
	1981 Average	111.5	141.0	153.2	151.2	139.2
	1982 Average	118.2	147.1	153.0	151.8	141.0
	1983 Average	71.1	92.6	95.7	99.9	89.8
	1977-83 Average	105.5	123.9	131.7	131.2	122.9

Table 6. Oats yields (bushels/acre) for seven years 1977-83 in the crop sequence study at Lancaster Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
CSbCOM	Ave. Six Year 77-82	32.7	43.4	53.0	64.5	48.4
	1983	52.3	52.9	70.8	72.8	62.2
	(77-83)Seven Year Ave.	35.5	44.8	55.5	65.7	50.4
CCOMM	Ave. Six Year 77-82	50.6	59.1	64.3	69.5	60.8
	1983	62.8	78.0	75.8	92.1	77.2
	(77-83)Seven Year Ave.	52.3	61.8	65.9	72.7	63.1
	1977-83 Average	43.9	53.3	60.7	69.2	56.8

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Table 7. Soybean yields (bushels/acre) for seven years 1977-83 in the crop sequence study at Lancaster, Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
CSbCOM	Ave. Six Year 77-82	41.1	42.2	43.9	44.3	42.8
	1983	32.4	31.7	27.9	29.9	30.5
	(77-83) Seven Year Ave.	39.9	40.7	41.6	42.2	41.0

Table 8. Alfalfa hay (meadow) yields (tons/acre dry matter) for seven years 1977-83 in the crop sequence study at Lancaster, Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre) 0	50	100	200	Average
CSbCOM	Ave. Six Year, 77-82	4.17	4.10	3.94	4.46	4.17
	1983	3.16	3.43	3.11	3.07	3.19
	(77-83) Seven Year Ave.	4.03	4.00	3.82	4.26	4.03
CCCMM	Ave. Six Year 77-82	1.79	1.73	1.90	2.19	1.90
	1983	1.39	1.49	1.10	1.24	1.31
	(77-83) Seven Year Ave.	1.73	1.70	1.79	2.05	1.82
CCCMM	Ave. Six Year 77-82	4.28	4.27	4.46	4.57	4.40
	1983	4.15	3.92	4.02	4.10	4.05
	(77-83) Seven Year Ave.	4.26	4.22	4.40	4.50	4.35
CCOMM	Ave. Six Year 77-82	3.98	3.92	4.07	3.84	3.95
	1983	3.49	3.30	2.62	2.84	3.06
	(77-83) Seven Year Ave.	3.91	3.83	3.86	3.70	3.82
CCOMM	Ave. Six Year 77-82	4.28	4.26	4.29	4.18	4.25
	1983	4.13	4.39	4.36	3.38	4.07
	(77-83) Seven Year Ave.	4.26	4.28	4.30	4.07	4.22
CCMM	Ave. Six Year 77-82	2.02	2.05	2.22	2.16	2.12
	1983	1.56	1.22	1.72	1.31	1.45
	(77-83) Seven Year Ave.	1.95	1.93	2.15	2.04	2.02
CCMM	Ave. Six Year 77-82	4.47	4.38	4.55	4.44	4.46
	1983	3.88	3.61	3.86	3.94	3.82
	(77-83) Seven Year Ave.	4.39	4.27	4.45	4.37	4.37
Cont meadow	Ave. Six Year 77-82	3.71	3.65	3.72	3.68	3.69
	1983	4.22	4.03	4.32	3.80	4.09
	(77-83) Seven Year Ave.	3.78	3.70	3.81	3.70	3.75
	1983 Average	3.25	3.17	3.14	3.09	3.16
	(77-83) Seven Year Ave.	3.54	3.49	3.57	3.59	3.55

Table 9. Analysis of variance of crop yields for seven years 1977-83 in crop sequence study at Lancaster, Wisconsin

Source	Corn d.f.	Corn Significance	Alfalfa d.f.	Alfalfa Significance	Oats d.f.	Oats Significance	Soybeans d.f.	Soybeans Significance
Replication	1	NS	1	NS	1	NS	1	**
Years	6	**	6	**	6	**	6	**
Phase/ sequence	9	**	7	**	1	**	-	-
Years x phase	54	**	42	**	6	NS	-	-
Nitrogen level	3	**	3	NS	3	**	3	NS

*, **, NS refer to 0.05 and 0.01 probability level and nonsignifiance, respectively.

Table 10. Weather summary - 1983 growing season at the University of Wisconsin experimental station at Lancaster, Wisconsin

Month	Temperature Ave. max.	Ave. min.	Ave.	Depart-ure1/	Precipitation Total	Depart-ure1/	Growing Degree Days (50°) 1983	Departure1/
April	52.2	33.2	42.7	-3.8	2.34	-0.83	(59)	-
May	64.8	44.0	54.4	-3.4	5.18	1.73	186	-114
June	80.6	57.4	69.0	2.0	3.28	-1.27	570	+ 55
July	86.5	63.8	75.2	3.8	3.34	-0.95	748	+ 88
August	88.3	63.2	75.7	6.8	3.12	-1.50	751	+156
September	74.4	51.0	62.7	1.8	3.81	0.37	414	+ 62
October	61.1	40.8	51.0	0.5	2.81	0.64	(99)	
					23.88	-1.81	2669	+247

1/Departure normal values determined from U.W. Exp. Sta., Lancaster, WI weather data accumulated since 1963. Current seasons values used in calculating long term means i.e., 21 years data, including 1983 data.

Last day in spring with minimum temp:	32° or	May 9 (31°)
	28° or	April 30 (28°)
First day in fall with minimum temp:	32° or	October 13 (28°)
	28° or	October 13 (28°)
1983 Growing season 32° or higher =	157	
long term average =	158	

Table 11. Cultural information for the 1983 crop sequence study at Lancaster, Wisconsin

	Corn	Oats	Alfalfa	Soybeans
Variety	Pioneer 3780	Marathon	Blazer	Hodgson
Planting date	May 17	April 23	April 23	May 17
Planting rate	28,000/acre	3 bu/acre	15 lb/acre	75 lbs/acre
Row width	30 inch	drilled	drilled	30 inch
Cultivation	2	-	-	2
Rotary hoe	-	-	-	-
Insecticide	Counter (planting)	-	Malathion (8/2)	-
Herbicide	2 qts/acre Bladex 4L 2 pts/acre Dual	-	Eptam 7E (on direct seeded)	Dual Sencor
Harvest date	October 10	July 28	June 6 July 11 August 22	October 10
Fertilizer	May 4 0-0-60 @200 lbs/acre applied to all plots September 12 0-14-42B @500 lbs/acre applied to alfalfa plots			

*Corn plots were chiseled and disced.

**Direct seeded alfalfa was not harvested on June 6, but was harvested on July 11 and August 22.

Table 12. Corn yields (bushels/acre adjusted to 15.5% moisture) for 1967-76 compared with 1977-83 yields in the crop sequence study at Lancaster, Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre)* 0 / 0	50 / 75	100 / 150	200 / 300	Average
Cont corn	1967-76	70.37	107.99	117.55	114.49	102.15
	1977-83	34.80	84.00	103.60	126.6	87.3
CSbCOM	1967-76	118.89	134.92	132.46	131.46	129.42
	1977-83	115.7	123.5	128.0	128.0	123.8
CSbCOM	1967-76	118.57	128.58	131.09	125.06	125.82
	1977-83	119.7	129.9	135.9	130.4	129.0
CCCOM	1967-76	116.25	123.87	125.21	129.46	123.66
CCCMM	1977-83	130.0	131.1	140.3	132.7	133.7
CCCOM	1967-76	96.11	120.26	120.49	121.06	114.49
CCCMM	1977-83	93.0	116.3	130.7	130.3	117.6
CCCOM	1967-76	79.47	111.30	120.11	120.57	108.15
CCCMM	1977-83	77.5	115.2	124.7	127.3	111.2
CCOMM	1967-76	125.91	130.49	135.54	129.61	130.36
	1977-83	128.6	136.0	136.0	134.8	134.0
CCOMM	1967-76	99.57	124.15	124.43	125.78	118.49
	1977-83	104.5	125.9	135.3	133.7	124.9
COMMM	1967-76	124.47	131.64	135.37	131.34	130.70
CCMM	1977-83	136.3	140.7	140.5	132.2	137.4
CCMM	1977-83	112.3	126.1	140.1	137.0	128.8
Average	1967-76	105.5	123.7	126.9	125.2	120.4
Seven-year ave.	1977-83	105.5	123.9	131.7	131.2	122.9

*0, 50, 100, 200 lbs/acre nitrogen was applied in 1977-83 and 0, 75, 150, 300 lbs/acre nitrogen was applied in 1967-76.

Table 13. Oats yields (bushels/acre) for 1967-76 compared with 1977-83 yields in the crop sequence study at Lancaster, Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre)* 0 / 0	50 / 75	100 / 150	200 / 300	Average
CSbCOM	1967-76	47.4	56.9	66.0	69.0	59.8
	1977-83	35.5	44.8	55.5	65.7	50.4
CCCOM	1967-76	51.8	59.7	67.4	75.3	63.6
	1977-83	(DISCONTINUED)				
CCOMM	1967-76	53.8	59.6	70.1	66.2	62.4
	1977-83	52.3	61.8	65.9	72.7	63.1
COMMM	1967-76	54.3	59.3	70.2	66.9	67.8
	1977-83	(DISCONTINUED)				
Average	1967-76	51.8	58.9	68.4	69.5	62.1
Seven Year ave.	1977-83	43.9	53.3	60.7	69.2	56.8

*0, 50, 100, 200 lbs/acre nitrogen was applied in 1977-83 and 0, 75, 150, 300 lbs/acre nitrogen was applied in 1967-76.

Table 14. Soybean yields (bushels/acre) for 1967-76 compared with 1977-83 yields in the crop sequence study at Lancaster, Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre)* 0 / 0	50 / 75	100 / 150	200 / 300	Average
CSbCOM	1967-76	34.7	36.4	37.3	37.5	36.4
Seven Year Ave.	1977-83	39.9	40.7	41.6	42.2	41.0

*0, 50, 100, 200 lbs/acre nitrogen was applied in 1977-83 and 0, 75, 150, 300 lbs/acre nitrogen was applied in 1967-76.

Table 15. Alfalfa hay (meadow) yields (tons/acre dry matter) for 1967-76 compared with 1977-83 yields in the crop sequence study at Lancaster, Wisconsin

Crop Sequence	Year	Nitrogen level - applied to corn (lbs/acre)* 0 / 0	50 / 75	100 / 150	200 / 300	Average
csbcom	1967-76	3.4	3.4	3.5	3.4	3.4
	1977-83	4.0	4.0	3.8	4.3	4.0
ccocm	1967-76	3.5	3.4	3.5	3.6	3.5
cccmm**	1977-83	1.7	1.7	1.8	2.0	1.8
cccmm	1977-83	4.3	4.2	4.4	4.5	4.4
ccomm	1967-76	3.3	4.3	3.4	3.5	3.4
	1977-83	3.9	3.8	3.9	3.7	3.8
c comm	1967-76	3.4	3.3	3.4	3.5	3.4
	1977-83	4.3	4.3	4.3	4.1	4.2
comm	1967-76	3.5	3.3	3.5	3.4	3.4
comm	1967-76	3.2	3.3	3.4	3.2	3.3
comm	1967-76	3.2	3.2	3.2	3.1	3.2
ccm	1977-83	2.0	1.9	2.1	2.0	2.0
ccm	1977-83	4.4	4.3	4.5	4.4	4.4
cont. meadow	1977-83	3.8	3.7	3.8	3.7	3.8
ten year ave.	1967-76	3.7	3.6	3.7	3.6	3.7
seven year ave.	1977-83	3.5	3.5	3.6	3.6	3.6

*0, 50, 100, 200 lbs/acre nitrogen was applied in 1977-83 and 0, 75, 150, 300 lbs/acre nitrogen was applied in 1967-76.

** Direct seeded in 1977, 1978, 1979, 1980, 1981, 1982 and 1983. The continuous meadow was reseeded (direct) in 1980. The stands in the continuous meadow plots were excellent in 1981, 1982, and 1983.

1977-83 CROP SEQUENCE EXPERIMENT PROGRESS REPORT

(Illinois, Iowa, Minnesota and Wisconsin – seven years of a modified crop sequence study based upon a previous ten year crop sequence study conducted 1967-76.)

Cooperating Researchers

Dr. Walt Wedin (Iowa State University)
Dr. Rick Cruse (Iowa State University)
Dr. John Webb (Iowa State University)
Dr. Don Graffis (University of Illinois)
Dr. Joe Jackobs (University of Illinois)
Dr. Jim Swan (University of Minnesota)
Dr. Art Peterson (University of Wisconsin)
Dr. William Paulson (University of Wisconsin)
Dr. Roger Higgs (University of Wisconsin)

Six different rotations: continuous corn, continuous meadow, CSbCOM, CCCMM, CCOMM and CCMM were compared in 1977-83 at the Lancaster Experiment Station in southwestern Wisconsin. Nitrogen was applied to corn in the rotations at rates of 0, 50, 100 and 200 pounds per acre. The 1977-83 plots were either continuations or alterations of plots utilized in a ten year crop sequence study conducted from 1967 to 1976. The continuous corn, CSbCOM and CCOMM sequences are the same as the previous ten year study. The continuous meadow, CCCMM and CCMM are new sequences which were begun in 1977. The first year meadow is directly seeded without a companion crop in the CCCMM and CCMM rotations.

The average yields of corn, oats and hay were 33.1 bu/acre, 10.5 bu/acre, and 0.4 tons below the seven year average (1977-83) because of drought stress in June, July and August. The yields of direct seeded alfalfa (CCMM and CCCMM) were the lowest in seven years of comparisons.

Table 1. Summary of 1983 yields for corn (bu/acre adjusted 15.5% moisture) oats, soybeans and alfalfa hay (meadow) (tons/acre dry matter) averaged for two replications

Crop	Sequence	Nitrogen level - applied to corn 0	50	100	200	Average
Corn	Cont. corn	22.9	66.2	81.7	91.9	65.7
Corn	CSbCOM	78.7	110.6	110.6	104.4	101.1
Corn	CSbCOM	81.7	95.2	90.0	104.2	92.8
Corn	CCCMM	84.8	88.7	100.4	105.4	94.8
Corn	CCCMM	51.4	74.7	93.0	101.7	80.2
Corn	CCCMM	63.0	88.0	88.5	85.6	81.3
Corn	CCOMM	99.8	93.7	94.6	108.1	99.1
Corn	CCOMM	58.9	94.1	86.9	97.8	84.4
Corn	CCMM	102.4	117.6	106.5	94.8	105.4
Corn	CCMM	67.6	97.1	105.0	104.8	93.6
Corn	1983 Average	71.1	92.6	95.7	99.9	89.8
Oats	CSbCOM	52.3	52.9	70.8	72.8	62.2
Oats	CCOMM	62.8	78.0	75.8	92.1	77.2
Oats	1983 Average	57.6	65.5	73.3	82.5	69.7
Soybeans	CSbCOM	32.2	31.7	27.9	29.9	30.5
Alfalfa	CSbCOM	3.2	3.4	3.1	3.1	3.2
Alfalfa	CCCMM	1.4	1.5	1.1	1.2	1.3
Alfalfa	CCCMM	4.2	3.9	4.0	4.1	4.1
Alfalfa	CCOMM	3.5	3.3	2.6	2.8	3.1
Alfalfa	CCOMM	4.1	4.4	4.4	4.4	4.3
Alfalfa	CCMM	1.6	1.2	1.7	1.3	1.5
Alfalfa	CCMM	3.9	3.6	3.9	3.9	3.8
Alfalfa	Cont. alfalfa	4.2	4.0	4.3	3.8	4.1
Alfalfa	1983 Average	3.3	3.2	3.1	3.1	3.2

NATIONAL PLAN FOR INTEGRATED PEST MANAGEMENT: RESEARCH, EDUCATION AND TECHNOLOGY TRANSFER

Prepared by: The National Integrated Pest Management Coordinating Committee

February 27, 1984

EXECUTIVE SUMMARY

Objective

To develop systems that will allow producers to manage crop and livestock pests (weeds, insects, pathogens and nematodes) and significantly reduce yield losses and increase production efficiency and profitability.

Justification

A major issue confronting American agriculture is maintaining its unique comparative advantage in crop and livestock production in light of increasing international competition, low farm prices, future resource constraints and environmental concerns. The issue requires a consistent, national commitment to discover and transfer new technology, products and management systems for the agricultural sector that enhance production efficiency and profitability. Systems approaches, particularly Integrated Pest Management, will play key roles in the future because of their abilities to blend economic, ecologic, biologic and environmental concerns and issues into profitable, production systems.

Pests are clearly recognized as a major limiting factor in agricultural production and profitability. Farmers expend 30 to 50% of their non-capital expenditures to control and manage pests. Most agriculturalists believe that considerable savings can be made in this area if new knowledge is gained and provided to the producer in an integrated manner.

Within the last decade, emphasis has been placed on developing and using integrated systems for managing pests. This integrated pest management (IPM) approach uses a defined system of crop or livestock production as its basis. IPM is factored into the production system as a major component and impacts on nearly every phase of production.

The intended goal of IPM research is to more clearly define and understand the relationships of pests, their hosts (crops and livestock), their natural control factors, and

the environment so that protection strategies can be more accurately addressed. This goal represents a major advancement in dealing with the management of multiple pests. Rather than considering pests as single entities, IPM deals with them as a complex exerting multiple interactions with the crop or animal host. IPM then is a systems approach that goes beyond the pest arena into the production arena as well. It is well known that many production decisions result in increased pest problems, and vice versa. In the IPM approach the full production system is dealt with holistically, requiring the strong cooperation of scientists working across disciplinary lines using the integrating concepts and principles of systems science.

An education component must also be woven into any IPM program, for it too requires new concepts, methodologies and commitment. If systems of production/protection are to be the way of the future, teachers as well as students must be trained and educated to deal on the interdisciplinary, holistic basis. It is not adequate to merely add on courses from the other key disciplines for curricula to grow to unrealistic lengths and integration science is not the sum of the parts—someone (the teacher) must have a systems mind-set and capability to teach interdisciplinarily.

Approach

Because the development of IPM systems that are imbedded in production systems is a large and complex task, requiring new principles as well as methodologies, this National Plan calls for focusing efforts on 10 major production systems across the U.S. and coordinating research from a regional and interregional basis. The research elements will be conducted by SAES, ARS and ERS scientists operating at their university or base location within a framework of systems objectives developed by Regional Technical Advisory Committees (RTAC's). Technology transfer activities will be conducted at the state level by extension specialists and field staff. Activities to increase and to produce educational materials and to increase the ability of selected faculty to teach IPM will be conducted regionally and in selected states.

The four RTAC's have conceived operational approaches appropriate to the region and to set priorities for IPM research, education and technology transfer. All regional priorities are the product of state priorities as to where major information needs data bases, scientific interest and expertise, and opportunities for impact exist.

The priority areas by regions are:

West	North Central	South	Northeast
Range	Corn	Cotton	Potatoes
Alfalfa	Confined Livestock	Soybeans	Forage Crops
Small Grains	Potatoes	Livestock and Poultry	Tree Fruits
Tree Fruits			
Potatoes			

Each regional priority will have a lead scientist as coordinator and they will act together to coordinate across regions in areas of project overlap, such as with potatoes.

Funding

Currently, there are two sources of Federal earmarked IPM funds associated with the goals and objectives of this National Plan. USDA-Extension provides Smith-Lever 3(d) funds ($7.531M) to the states on a formula basis for implementation of IPM programs. USDA-Cooperative State Research Service provides approximately $3.1M of Public Law 89-106 funds to the Consortium for Integrated Pest Management (CIPM) for research on cotton, soybean, alfalfa and apple IPM. Funding for the five year proposal will be complete in 1984.

It is proposed that in FY 1984 the funds in CSRS be allocated to CIPM (ca. $1.8M) and the National IPM Program (ca. $1.3M). This arrangement will enable CIPM to fully complete its five year program and the regions to complete their systems planning and initiate research. The ca. $1.3M would be allocated to the regions using the Regional Research Fund formula. Each region will recommend to CSRS how these funds will be allocated to address the high priority research needs identified in the regional planning process. No change is proposed for Extension IPM program funding mechanism.

In the following five years (FY 1985-89), it is proposed that the entire ca. $3.1M and increases, if any, be allocated to the regional IPM programs detailed here. It is further proposed that ARS match the CSRS funds and allocate resources to scientists researching priorities identified in the regional planning process. It is also suggested that the Directors of Resident Instruction develop a pool of resources from which regional activities for IPM teaching could be supported. Because Extension programs are locally determined, Extension IPM funds should continue to be allocated to states for

their ongoing programs. The role of the economist in IPM is critically important, and to that end it is suggested that the Economic Research Service obtain resources to each region's IPM projects.

Program Review

To assure that progress is made, objectives are fulfilled, and funds are invested in productive scientists, reviews of progress and accomplishments will be conducted annually. Of course, project coordinators will encourage and review progress on a much more frequent basis. An appropriate review process will be developed for each region, and it is envisioned that review panels will be drawn from peers outside of the program and often from outside of the particular region. The Regional Technical Advisory Committees will be responsible for the review process. Results of reviews will be used by administrative advisors and production system coordinators formulation of periodic recommendations to responsible administrators.

PRELUDE AND OBJECTIVES

This plan is the product of the National Integrated Pest Management Coordinating Committee which was appointed by ESCOP, ECOP, RICOP, ARS, and ERS in 1981. The plan develops a national framework for IPM for research, technology transfer, and education personnel in the Land Grant University and USDA system to cooperatively implement optimal systems for managing crop and livestock production systems. The IPM plan will have major impact on agricultural efficiency and profitability, by reducing the cost for protecting crop and livestock against pests which represents 30 to 50% of the non-capital expenditures of farming.

This document presents organizational objectives that will allow systematic pursuit of ennumerated biological, economic and environmental objectives.

Organizational Objectives

1. To describe current research, technology transfer, and teaching efforts in IPM to maximize coordination and development of future programs;
2. To establish a plan for future activities in interdisciplinary agricultural production that will integrate strategies and systems for pest control within selected (prototype) agroecosystems; and
3. To enhance opportunities for development and coordination of interagency,

interdisciplinary IPM programs for specific agroecosystems of regional and national importance.

Biological, Economic and Environmental Objectives

1. To develop production system models for the purpose of detailing the functions of each agroecosystem being studied;
2. To reduce crop and livestock losses due to pests (insects, weeds, nematodes vertebrates, and plant pathogens) in an economically sound manner; and
3. To design and provide for implementation of pest management systems and associated strategies and tactics into selected agroecosystems in an environmentally sound manner.

THE CHALLENGE AND OPPORTUNITY

Recognition of Need to Improve Agricultural Production Efficiency and Profitability

Agriculture and agricultural sciences in the United States are at important crossroads. American agriculture has reached an apparent plateau in efficiency. Efficiency is critical to agriculture, as it is to any industry, in the maintenance of comparable advantages and profitability. Increases in yield that have characterized U.S. agriculture often have not meant increased profit to the producer. In fact, foreclosures of U.S. farms have seldom been higher and the lure of farming to the next generation is at an all-time low.

Imbedded in the collective philosophies of agricultural scienees is the ability to recognize and adapt to perceived needs. Agricultural sciences are unique in their system of state and federal research and extension agencies, operating in a partnership. The system is well suited to address and solve the efficiency/profitability challenge facing U.S. agriculture. Beyond the crossroads looms the apparent need to find the means to capitalize on the strong <u>disciplinary</u> bases that have been established in agricultural sciences and to pursue systems of conducting research and technology transfer (the adoption and application of resulting new technologies in extension and teaching programs) on an <u>interdisciplinary</u> basis. Through careful interdisciplinary programming, we will better understand the multitude of interactions between biological, environmental, economic, and social components of agriculture and, thereby, solve the efficiency-profitability questions. Because of the complexity of these interactions, it is essential to introduce the concept and skills of <u>management</u> into the educational component of

Integrated Pest Management (IPM) programs. This action will require a careful review of IPM components of existing research programs, curricula, and extension communication programs.

During the past 10 years, several programs have emerged that begin to address the need to develop multistate, interagency, integrated systems of managing and conducting research, extension, and teaching. Examples include: the Solution to Environmental and Economic Problems (STEEP) Program in the Pacific Northwest; the National Atmospheric Deposition Program (dealing with acid rain); and the Consortium for Integrated Pest Management (CIPM). The latter involves 16 states and over 250 scientists working together to develop crop protection systems for 4 major U.S. commodities—alfalfa, cotton, soybeans and apples.

Integrated Pest Management as a Means of Improving Production Efficiency and Increasing Agricultural Profitability

Integrated Pest Management (IPM) is a concept and philosophy that enables development of comprehensive, unified and efficient systems of crop and animal protection through the integrated use of suppression (control) tactics that are compatible with economic, ecologic and sociologic goals. Because IPM deals primarily with agricultural production systems and has integration of components as its basis, it is one major approach that is making significant inroads into the efficiency/profitability issue. This has been documented through economic evaluations of a number of commodity programs implemented by growers in several states.

Understanding the IPM Concept and the Challenge of Integrating Agricultural Disciplines

Integrated pest management research, extension and teaching programs are underway in every state and may be the most widely recognized new agricultural program thrust in the last ten years. Yet the definition of IPM is extremely pluralistic. IPM is interdisciplinary in nature, but each participating discipline maintains its own identity. Therefore, IPM has various meanings. Some disciplines see pesticides as the dominating control component in IPM, while others focus on natural enemies, cultural practices, and host plant resistance.

Most IPM specialists and practitioners now recognize the term "integrated" in IPM as four-fold in meaning. First, being integrated, it calls for an interdisciplinary approach where all classes of pests and their interrelationships are jointly considered. Second, it

requires that all available management tactics be coordinated into a unified program seeking an optimal management strategy. Third, crop protection is treated as but one aspect of the "integrated" management program of the agroecosystem. Finally, IPM recognizes the necessity of addressing economic, ecological, and social concerns.

Complex agricultural issues must be addressed using the systems science approach to the problem-solving process. This methodology is best suited to deal with the complexity of an agroecosystem and it provides the means to first understand the holistic nature of an issue and then to devleop system integrated solutions.

The goal of IPM is to develop and implement crop and livestock management strategies that are truly interdisciplinary in design. Perhaps there never was a non-IPM philosophy, only a tendency to provide recommendations on a discipline-by-discipline, event-by-event basis. Over time, in this classical approach, recommendations of one discipline often interfere and conflict with those from another. For example, one discipline could recommend a fungicide that controls a plant disease. Yet, this fungicide might "go across discipline lines" and eliminate beneficial fungi that attack and check an insect pest population. While controlling a plant disease on one hand, this management strategy could cause an outbreak in the pest insect population on the other hand. To ignore this problem is non-IPM, to address it is IPM. In an integrated approach, such conflicts between disciplines and strategies are commonplace and therefore must be resolved in advance of implementation.

A major intent of IPM is to integrate crop/livestock protection and production disciplines to implement an ecologically sound and economically stable plant protection approach for agricultural crop/livestock production. But discipline integration for the purpose of developing IPM has major constraints. Most institutions have "invested" more than a hundred years in developing strong discipline-oriented programs and administrative units supportive of these programs. In the future, another, equally strong, dimension must be added. The administrative unit's charge will be to encourage and facilitate truly interdisciplinary programming, without creating new units, buildings or institutes. The strength of any interdisciplinary program is based on the strength of a participant's discipline. Several large universities have established coordinatorships for IPM to foster high levels of interaction between disciplines and the need for IPM research, extension, and teaching.

Successes to Date

Since the early 1970s, implementation of integrated pest management practices

has dramatically reduced pesticide use on some commodities and has improved the efficiency of production and economic returns for the farmer. This was made possible through improved environmental and biological monitoring, better understanding of the economic threshold concepts, and improved communication systems, pest resistant plant types, among others. For example, in Texas, the development and implementation of short season cotton production systems, combined with cultural controls, conservation of native predators and parasites, use of selected pesticides and other agrichemicals, and by using timely scouting has reduced the use of insecticides in cotton from 20 million pounds in the late 1960's to 2 million pounds today. This has meant a savings of millions of dollars to Texas farmers, reduced environmental insult and saved some production areas such as the Coastal Bend area of Texas from losing cotton as a cash crop by avoiding resistance of pests to chemical pesticides. Similar examples could be cited from IPM programs on alfalfa, soybeans and apples.

Probably the most pervasive success story is the contribution that IPM has made to introducing and emphasizing the importance of systems science and modeling to modern agriculture. These methods have produced many new ways to assess and determine priorities in research, and provided many management and decision aids through the development of pest-plant models, computerized networks for forecasting pest outbreaks, predicting crop yields and increasing the flow and speed of information delivery to county extension specialists and growers.

THE CURRENT APPROACH

Background and Current Status of IPM Programs

The first large interdisciplinary project in IPM was the Huffaker Project (after Carl Huffaker, University of California, Berkeley) which was funded in 1972 by EPA, NSF and USDA and by EPA and USDA in its latter stages. The Huffaker Project brought together more than 300 scientists from 18 states in a multidisciplinary approach to integrated insect control on several commodities. In 1979, a follow-up project was funded by EPA and then by USDA. This project involved other pest control disciplines on an equal basis with entomology as well as continuing to emphasize systems science and modeling and the economics of IPM. The Consortium for Integrated Pest Management (CIPM) involves 17 universities, ARS participation, and includes more than 250 scientists in an interdisciplinary approach to the integrated control of all multiple pest categories on four major crops (alfalfa, apples, soybean, and cotton). CIPM is scheduled to

terminate March 1, 1985, after five very successful and productive years. There have also been other IPM programs of lesser scope or dimension that have made significant contributions to the development of IPM as we now know it.

Recognizing that some type of on-going national plan for IPM needed to be developed within the USDA and Land Grant System, the Director of SEA (Science and Education Adminstration) in 1980 asked the Experiment Station Directors, Extension Directors, Deans of Resident Instruction and ARS, CSRS, and ERS to consider the development of a structure for the regional organization of IPM. Organizations at the regional level would provide a mechanism for the states and regions to identify interdisciplinary priorities in IPM.

Regional and national interdisciplinary research and education planning across agencies was further enhanced by the appointment of the National IPM Coordinating Committee in 1982, by ESCOP, ECOP, RICOP, USDA-ARS, -CSRS, -ES, -ERS.

Each of the regions (as defined by CSRS) have identified priority commodities and are presently at various stages of evolving IPM projects. During FY84, approximately $1.3 million of the final year of the Consortium for Integrated Pest Management (CIPM) budget will be utilized to provide funds for making an orderly transition from CIPM to the regional planning and implementation concept. It is anticipated that these funds as well as future research funds will be allocated to the four regions based upon the formula for regional funds or some other agreed upon distribution plan.

Using the Regional Concept and Mechanism to Further IPM Developments in Major Production Systems

Production systems in agriculture are very complex. The components and interactions which make the system operate require concerted study. Yet if scientific and managerial teams are going to improve the efficiency and profitability of given systems, the nature of the system in both conceptual and quantitative terms will have to be well known. Moreover, the pest component is complex (with its many interactions with the environment, plant and animal development, pesticides, crop varieties and natural enemies) and well imbedded in the overall production system model. Improvements in one component, such as crop protection, can hardly be expected to be lasting and financially satisfying unless integrated with the full system. The earlier and current large scale programs in IPM have made significant inroads into: 1) understanding how pests, plants/animals and environment interact; 2) developing biological monitoring (pest scouting) approaches to properly time pest control treatments; 3) improving plant

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cultivars that better tolerate pests and other stresses; 4) using computers to analyze pest-ecosystem situations and communicate pest alerts and management recommendations; 5) developing new pest control tactics; and, perhaps most significantly, 6) demonstrating the pay-offs that can occur when disciplinarians work together on a interdisciplinary basis to tackle complex problems.

A start has been made, and the successes to date are numerous. There is little doubt that the IPM approach will work; many say there are no other choices. The next logical step is to integrate IPM in the production system. This will bring plant and animal protection scientists and educators close together with those of the production and social science disciplines to facilitate integration of protection strategies with production system strategies and goals. This will increase production efficiency and profitability.

The National IPM Coordinating Committee, chaired by Dr. Ray Miller, University of Idaho, and comprised of representatives from various USDA agencies and regions, believes that the most realistic way to approach this next stage is to focus attention on 10 major production systems, selected by the four Regional Technical Advisory Committees, so that unified and comprehensive systems of IPM will emerge to be used as prototypes for IPM programs on other commodities and production systems. Unless resources are focused on a few agricultural production systems, the expertise, staff and fiscal support will be inadequate to permit the development of unified and comprehensive IPM systems. Without this focus, it is envisioned that only relatively incomplete, somewhat superficial systems would be achievable and American agriculture would be deprived of advanced, integrated IPM programs.

Why conduct the programs on a regional basis? Two primary reasons: 1) few, if any, states or ARS locations have the necessary cadre of specialists on staff and available to study the complexity of a production system and develop improved systems of plant/animal protection, and 2) most pests and crops are regionally distributed and regulated (by environment, type of varieties, etc.). The "pooling" of resources and the definition of problems and objectives on a regional basis would enhance IPM system developments over an approach where universities or ARS tried to do it alone. Currently, many states and ARS locations simply do not have such IPM experts such as resource economists and system scientists on staff, let alone available, to work on IPM projects.

The approach proposed here utilizes the existing administrative USDA regions as the primary planning units. This maximizes the opportunities to institute the inter-

disciplinary-interagency planning process at the scientist level and is a system that is highly sensitive to the unique problems and issues of individual states and regions. Regional Technical Advisory Committees (RTAC) consisting of scientists representing ARS, SAES, CES, resident instruction and other appropriate units are addressing the IPM research, extension, and teaching needs and establishing the approaches to be used within each region. In some instances, the same commodity (e.g. potatoes) has been identified for the IPM effort within more than one region. In these instances scientists representing each region involved will meet periodically to devise appropriate means of coordinating research objectives, sharing research data and extension and educational materials. Interregional projects will eliminate duplication and provide a means of assuring that the highest priority research endeavors are undertaken.

Extension will participate in RTAC's and the National IPM Coordinating Committee to insure that the Extension roles of education, technology transfer feedback, research adoption and program evaluation are considered in the regional and national planning process.

Teaching faculty at the various Land Grant Universities will participate by cooperatively developing educational and training materials; computer simulation programs for production systems and IPM optimization, etc.; and courses to improve teaching of this integrated subject area. Some teaching funds may be coordinated regionally to expedite production of materials common to the region, but most of the funding decisions will be made at the state level. In some states the IPM Coordinator is also responsible for the IPM curriculum.

Intensive workshops are envisioned for research, teaching and extension staff to increase the competency level of the human resource in areas central to IPM. Workshops on computer modelling, computer simulation, planned change concepts for implementation of new technology, principles and techniques for educating the adult (clientele), principles for optimization, economics of alternative pest management strategies, and others will be developed. These learning sessions will be organized by the Regional Technical Advisory Committees and hosted by one of the participating states. When appropriate, interregional attendance and participation will be encouraged. The audience will be comprised of the appropriate mixture of research and teaching staff, extension field staff, ARS research staff and representatives from the private sector.

FOUR REGIONAL PROGRAMS IN PLACE WITH PRIORITIES AND WORK PLANS

The four regional programs have all been planned by the representative Regional Technical Advisory Committees (RTAC). Each of the four RTAC's is comprised of scientists representing each state of the region. The participants were selected in such a way as to assure representation of the key protection and production disciplines (such as weed science, entomology, plant pathology, nematology, horticulture, agronomy, animal science, biometeorology and agricultural economics). Moreover, care was taken in each region to adequately represent teaching, extension and research interests on the RTAC. Administrative Advisors from USDA-CSRS, -ARS, -ES and -RI have been integral to the planning process in each region.

Western Region IPM Program

Background

The Western Region IPM program was established in 1978. The project has evolved from an experiment station coordinating committee to regional project with strong representation from experiment station, ARS, extension and teaching personnel.

The project is designed to address development of integrated pest management programs in teaching, research and extension for the semiarid agroecosystem of the western region. This ecosystem is of major importance to all contiguous western states, is the largest in the region, and generates the highest dollar return to producers.

Priorities

Priorities include those commodities grown without cultivation and additional water (rangeland) or with cultivation and additional water (cotton, corn, sugarbeets and potatoes). Alfalfa and small grains are viewed as transitional commodities as they may be grown as either an irrigated or dryland component of the agroecosystem.

Initial objectives were to assess the impact of pests and plant protection by individual commodities and crop production systems; to identify and prioritize pest complexes amenable to IPM; to develop, refine and implement IPM systems for selected pest complexes by obtaining or refining additional biological and climatic data; and to initiate systems analysis, modeling and simulation technologies for individual commodities and subsequently developing and implementing new IPM systems.

Current Status

Seven subcommittees representing the seven commodities included in the project were formed. Each subcommittee had representatives from extension, experiment station, resident instruction and ARS units within the region. In several instances representatives from agribusiness were also appointed. These commodity coordinating (CC) subcommittees were charged with the responsibilities of prioritizing all pest problems for the individual commodities within the region and identifying serious pest complexes amenable to an IPM approach for control. These activities are now complete for all commodities except rangeland. Several pest complexes amenable to an IPM approach for control were identified and efforts are currently underway to initiate research and extension efforts for these pest complexes by establishing Pest Complex (PC) subcommittees. The PC subcommittees are establishing special research, extension, and resident instruction priorities for each pest complex within the cropping system, and initiating appropriate programs to address these areas.

An additional activity of the PC subcommittees is to evaluate the need for first order manuals that will integrate pest management into the cropping cycle. These manuals are aimed at extension personnel, farmers, and pest control advisors. In addition these are to be used as supplements to resident instruction programs in pest management. Manuals for cotton, potatoes and small grains are at various stages of completion. A manual for alfalfa will be developed by modifying the current California IPM manual to make its content regional in scope. Manuals for sugarbeets and corn will not be developed at this time.

Future Direction

The project is being revised, but will continue to emphasize the semi-arid agroecosystem with several commodities dropped (sugarbeets and corn) and tree fruits added. The project will be substantially restructured to show more clearly the interdisciplinary, interagency focus of the effort and to better identify the relationship of the extension and resident instruction components within the project. The objectives of the revised project are: 1) to develop the knowledge base to solve specific pest complex problems identified for agroecosystems featuring rangeland, cotton, potatoes, alfalfa, small grains and tree fruit; 2) to develop Integrated Pest and Agroecosystem Management (IPAM) implementation systems for project agroecosystems; 3) to develop a model IPAM curriculum at both undergraduate and graduate levels with appropiate support materials;

4) to develop systems coordination across research, extension, and resident instruction activities (1-3 above).

These objectives are a significant departure from a traditional research project. Each component has a specific objective with an integrative systems objective (#4) linking the first three objectives.

Subobjectives will be developed for each commodity or pest complex involved. These subobjectives will vary and will address specific needs of the individual subprojects.

North Central Region IPM Program

Background

The North Central Region IPM Program began in January, 1981, with the first meeting of the 23 member NC-IPM Steering Committee. The committee was comprised of representatives from all of the states, the primary protection and production disciplines, CSRS, ARS, ES, and SAES. A research planning project entitled "Analysis of Production Systems and IPM Research Needs in the North Central Region" and designated NC-166 was approved beginning October 1, 1982.

Priorities

The RTAC (with concurrence of the Directors' Association) has selected three production systems for priority attention in the North Central Region. They are potatoes, corn, and confined livestock. These agroecosystems are serving as the prototypes for regional and state systems analysis. Task forces, with representatives from all 12 states, are analyzing the three prototype agroecosystems. From this activity, production decisions with appropriate options and their costs/benefits will be derived to construct production-protection decision trees for the systems being analyzed. The decision trees will be used to evaluate the consequences of alternative production activities or decisions and produce a prioritized list of regional IPM needs in research, extension, and teaching. Once the activity is completed for a prototype system, other cropping systems will be inserted into the process.

Current Status

In July of 1983, the NC SAES Directors allocated $135,000 of their Regional Research Fund, effective October 1, 1983, and split equally across the three production system task forces. Each task force is chaired by a Lead Analyst and consists of three

state representatives. The Lead Analyst received $30,000 and each state, $5,000.

The corn production system analysis is being led by Illinois with scientists from Indiana, Iowa and Ohio participating. Minnesota is leading the potato production system analysis; Michigan, North Dakota and Wisconsin scientists are assisting. The confined livestock production system analysis is chaired by Nebraska, with Kansas, Missouri and South Dakota scientists participating.

Presently, each task force is gathering the data necessary to produce a decision tree matrix for each of the prototype agroecosystems being studied. These production system models will enable each of the task forces to identify the systems components, to determine the relationship between and among the components, to determine the system's sensitivity points and data gaps, and to develop objective-specific recommendations for research and technology transfer activities.

Future Direction

By early 1985, the task forces will have completed their production system analyses of the prototype agroecosystems. Initial validation will be obtained using the Delphi Process to gain insight from specialists outside of the four states directly involved with the system's analysis. Objective-specific recommendations for research and technology transfer will be developed and presented to the North Central Director's Association by the RTAC at that time. A preliminary document will be available in the fall of 1984. Project leaders will be selected for research of each production system. Participating scientists will be selected by the Directors and the RTAC jointly. Funds will be allocated for work on specific objectives by individual scientists or small teams. It is envisioned that discipline-oriented objectives will be supported in each of the 12 states or several ARS locations from IPM funds received through an equitable funding mechanism. In many instances, scientists will be encouraged to submit proposals to the RTAC and Regional Directors' Association for funding to work on specific objectives. The project leaders will be responsible for project direction and integration and will receive special funding for these aspects. An annual review of projects will be conducted under the auspices of the RTAC. Extension and teaching personnel have been involved in the planning and task force phases and will be involved in all reviews to aid and facilitate the technology transfer and teaching processes.

Southern Region IPM Program

Background

The Southern Region IPM program began in late 1980. A Regional Technical Advisory Committee (RTAC) was appointed by the Southern Directors of Research, Extension, Academic Deans and ARS. Each southern state, Puerto Rico, the Virgin Islands, the 1890 Institutions and USDA-ARS were represented as to teaching, research, and extension interests in integrated pest management.

Priorities

In January of 1981, the RTAC established livestock and poultry, soybean, and urban pests as the top research and extension priorities. These priorities were amended in 1982, after it was evident that the Consortium for Integrated Pest Management (CIPM) would not continue, to include cotton IPM. A commitment also was made to educational needs in IPM, especially institutional manuals, computer aided instruction, autotutorial and audiovisual aids. The need for funded internships and fellowships was identified to provide training and experience in concepts of IPM.

Current Status

Work groups for livestock-poultry and soybeans were appointed by the Southern Directors of Research with representation from Extension. Regional project proposals were developed in each of these areas. SR-181, "Integrated Arthropod Management for Livestock and Poultry in the Southern Region," was approved in December 1982. California and New Mexico from the Western Region and ARS, Kerrville, have been approved as participants in this Southern Regional Project. This project will focus on economic losses caused by livestock and poultry pests, ecology, biology and population dynamics of these pests, and the development and integration of new and improved methodology into a cost effective management program. Plans are to coordinate this project with livestock IPM in the North Central Region. The soybean project entitled "Integrated Management of Soybean Pests in the Southern Region" has been developed and is in the approval process. This project will focus on changes in communities of soybean pests in response to each other and the changes in production practices, economic threshold functions for pest complexes, and the development of overall economically feasible IPM systems for soybeans. Close coordination to several regional projects dealing with closely related disciplinary and systems modeling research will be necessary.

Future Direction

Future direction for the Southern Region Program includes development of the cotton project. This is currently in the planning stages and will attack some of the priority research and extension implementation objectives not completed under the Consortium for Integrated Pest Management (CIPM), including production technology and integrated control tactics, systems analysis and modeling, economic analysis and cost-benefit demonstrations, and introductions of new technology. Also, the livestock-poultry and soybean projects will emphasize a strong production system approach by developing biological and economic models.

Additional thrusts will include IPM instructional and training programs for the southern region, with emphasis on manuals, autotutorial materials, videotape, interactive computer programs for classrooms, mobile laboratories for support of interns in the field and funding of internships. All 13 states and USDA-ARS will be involved. Virginia (VPI & SU) will lead the development of manuals and Florida and Texas A & M will provide the leadership for development of computer software.

The extension effort in the Southern Region will include establishment of priorities, coordination of extension materials for educational purposes amongst the various states, and development of IPM-related materials on an individual state basis.

Northeast Region IPM Program

Background

The Northeast Region IPM program was established in 1979 by the Northeast Region Extension, Agricultural Experiment Station and USDA-ARS Directors. A coordinating committee, consisting of representatives from Extension, Experiment Station, Resident Instruction and ARS, defined the objectives and established priorities for research, teaching and extension efforts under the regional thrust. The northeast IPM program was designed to stimulate additional research in IPM and to incorporate the findings into current extension and teaching programs across a region. The research was to be interdisciplinary, systems oriented, and concentrated in several regional priorities as established by the coordinating committee and approved by the directors.

Priorities

The original priorities, as established in the region, included vegetables, dairy-forage crops, tree fruits and urban pests. The vegetable priority was subsequently narrowed to potatoes. For each priority, a planning committee was formed to develop

plans for the regional IPM effort. Because of the uncertainty for additional funding, only the potato group was authorized at this time to prepare a full-fledged regional project. This was given the lead priority because of the critical nature of the pest problems on potatoes in the region.

Current Status

The potato project is in its final stages of preparation and should be approved early in 1984. It involves input of 8 of the region's 12 states. The forage project, which will have a strong interface with dairy production, is in the final planning stages and the projected implementation date is 1985. The tree fruit project is basically the northeast region's participation in CIPM; however, with the termination of CIPM, a regional tree fruit project will need to be developed during 1985. The urban pest priority is receiving secondary attention at this time and will probably be planned for funding by agencies other than USDA.

Future Direction

The Northeast Region will continue developing their IPM program under the regional project format within the criteria established for IPM. Emphasis will be placed on research that uses the approach of systems science, close coordination amongst the various agencies in the region (experiment stations, extension, instruction and ARS), strong liaison with related projects in the other regions, and clearly defined priorities within the region.

PROGRAM ORGANIZATION

National IPM Coordinating Committee

The National IPM Coordinating Committee consists of administrators and technical leaders from the four Regional IPM Programs and representatives from USDA-CSRS, -ARS, -ES, -ERS, and -RI.

The National IPM Coordinating Committee will continue to address those issues that are national rather than regional in scope. Specific responsibilities of the national committee could include:

1. Taking leadership for recruitment and preservation of national funding by initiating and maintaining contacts with regional and national administrators of ERS, ES, CSRS, ARS and RI. In addition, the committee will coordinate regional budget

requests and assist in preparation of budget analysis for USDA.

2. Maintaining contacts with other federal agencies, agribusiness, the Congress and other concerned constituents to assure that the national IPM program continues to have high visibility and priority.
3. Reviewing the status of the four regional IPM programs to assure that a regional, as well as interregional coordination is achieved, to eliminate duplication and to maximize coverage of research, extension and teaching issues in IPM.
4. Assisting in other areas at the request of the regional IPM committees or national associations or committees.

Regional Direction

Each of the four regions have identified priority IPM areas. These areas are listed below:

West	North Central	South	Northeast
Range	Potatoes	Livestock and Poultry	Potatoes
Alfalfa	Corn	Soybeans	Forage Crops
Small Grains	Confined Livestock	Cotton	Tree Fruits
Tree Fruits			
Potatoes			

Commodity efforts common to more than one region will be coordinated and other states can participate in projects outside their region. Because this proposed national IPM program is based on the state and regional efforts, the result is a broad but comprehensive inclusion of commodities and needs.

Regional Technical Advisory Committees

Each regional IPM program is directed by a Regional Technical Advisory Committee (RTAC) appointed by the Director of ARS, Extension, Instruction and Experiment Stations. Each RTAC has a chairperson or coordinator who is responsible for heading that committee as well as serving on the National IPM Coordinating Committee. In addition, the RTAC's are subdivided into committees that deal with specific commodities or problems. These may be subgroups of the IPM project of other regional committees. Each of these committees in turn has a chairperson to head the project and to help coordinate any national or interregional effort in that area or commodity.

Funding

Currently there are two sources of earmarked Federal IPM funds in addition to those funds allocated from regular State and Federal appropriations. The earmarked Federal funds include Extension Smith-Lever 3(D) funds that go to each state Extension Service by formula. The research funds are 89-106 funds (CSRS) that have been appropriated for the CIPM project (ca. $3.1M).

It is proposed that in FY-1984 the funds in CSRS be allocated to CIPM ($1.8M) and the national IPM program ($1.3M), with the national IPM funds to be allocated to the regions based on the RRF formula. Each region would recommend how the funds would be allocated in that region. Indications are that the regions would recommend these funds be allocated competitively, to address high priority research needs identified in the regional planning process. There are also resource needs for continued planning and identification of IPM research priorities.

The extension IPM funds are currently allocated by formula to each state. These funds have been used to establish IPM programs in each state. These programs need to continue and to expand in order to accomodate the results of the National IPM Program.

It is proposed that ARS match the research funds allocated through CSRS. These funds could be allocated in one of two ways at the discretion of the region. They may be competed for in the region by ARS scientists to be used on projects identified by the RTAC, or they may be pooled with the CSRS funds for competition by ARS and state scientists in that region.

For IPM concepts to be used in the field it is important to have individuals trained in the principles of IPM. Many colleges of agriculture have IPM training programs of one kind or another. But few if any of these have been developed or planned on a regional or national level. There is a need for some commonality of curricula, a sharing of materials, etc. Thus there is a need for resident instructions to be part of this total IPM effort with appropriate funding. It is suggested the Resident Instruction take two approaches: initially that the Directors of Resident Instruction in each region develop a formula and assessment system to have a pool of funds to develop curricula, material, etc.; and secondly that some of the National Agriculture Fellowship Funds, recently obtained by ARS, be allocated to competitive IPM fellowships in the four regions.

It is critically important that the current IPM funds be continued and that, as this proposed program develops, additional federal funds be appropriated. Such appropriations from the federal level will continue to direct substantial additional funds from individual state, extension, Hatch and ARS appropriations.

Progress and Accomplishments

Each regional commodity program and subproject will report annually its progress and accomplishments to the regional and National IPM Coordinating Committee and document progress through the CRIS reporting system. To assure adherence to the objectives of the regional program, an additional annual review of each project by a peer review panel will be conducted. These panels will review progress and accomplishments and programs, subprojects, and competitively funded proposals.

Review System

An appropriate interdisciplinary review system will be a component of each region, adequate provisions will be made to finance the travel of panel members. The members of regional review panels will usually be drawn from peers outside of the program. The RTAC will nominate members of review panels for each regional commodity project/work group. These panels will review progress and accomplishments of programs and subprojects, competitive proposals and make recommendations to RTAC's and Regional Directors. The purpose of the review is to: provide unbiased direction to the program; and to enhance the quality, accountability and interdisciplinarity of the program.

Interregional Education Workshops to Increase State Expertise and Skill

Recognizing that one of the primary reasons for conducting this IPM program on a regional basis is the lack, at most locations, of staff expertise to develop comprehensive and integrated IPM systems, workshops will be conducted annually to transfer skills and expertise to interested researchers, extension specialists and educators. Workshops are envisioned on biological and mathematical modeling, constructing farming decision trees, analyzing economics of alternative agriculture technology, and understanding the sociology of IPM implementation, i.e., understanding principles and concepts by which clients adopt or reject new technology.

In addition, interregional commodity specific scientific exchange sessions will be held to bring scientists working in different regions, on the same commodities, such as potatoes, together. These sessions will focus on coordination and exchange of findings, ideas and plans.

The workshops will be organized and conducted under the auspices of the National IPM Coordination Committee, usually by one of the RTAC's. Funding for this activity could come from Regional Research Funds, and/or from central funding sources of CSRS, ARS, ES, ERS, and RI.

Senator LEAHY. I believe, Mr. Myers, you are next in our road show here. The committee is happy to have Gary Myers, the president of the Fertilizer Institute from Washington, DC, here. Mr. Myers, on occasion I think probably feels that he has to have his mail forwarded to this committee; he spends so much time here.

But he is well respected by the Senators on both sides of the aisle of this committee, and we are always delighted to have him here.

STATEMENT OF GARY D. MYERS, PRESIDENT, THE FERTILIZER INSTITUTE, ACCOMPANIED BY WILLIAM C. WHITE, AGRONOMIST

Mr. MYERS. Thank you, Mr. Chairman; I appreciate those remarks. I would like to request that the full statement be entered as presented to the committee, and we will furnish a copy of the charts to the committee.[1]

With me this morning is Dr. William C. White, who is our agronomist on our staff.

Senator LEAHY. Dr. White, we are glad to have you here.

Mr. MYERS. He will be available to respond to questions.

Mr. Chairman, the Fertilizer Institute is pleased to respond to your invitation to present testimony here today relating to Senate bill 1128, entitled the Agricultural Productivity Act of 1983.

A little history on the Fertilizer Institute: It is a voluntary, nonprofit association whose members represent 95 percent of the fertilizer production in the United States. We have over 300 member companies. They produce, manufacture, trade and distribute fertilizer throughout the country.

Today, we cannot recommend full support for this bill, not because we are against agricultural productivity—indeed, the fertilizer industry has been a major contributor to productivity; not because we are against well-structured, sound agricultural research and soil conservation efforts—indeed, the fertilizer industry has been a major supporter of such research throughout more than a century; and not because we disfavor use of animal wastes, crop residues, green manures and other material commonly known as "organic."

Indeed, the fertilizer industry for years has encouraged incorporation of organic matters in the soils for soil structure improvement, erosion control, and the limited nutrient contributions available.

Mr. Chairman, let me lay out for the committee some facts regarding nutrient use by plants. Life processes, whether in green plants or humans, have certain basic requirements. For example, there is no protein without nutrient nitrogen, no ATP without phosphorous, and no carbohydrate metabolism without potassium.

When nutrients such as these are lacking or deficient, life processes are cut short. In plants, the results of such nutrient deficiencies are low crop yields. Not until the late 1800's did people begin to understand this and then start to supply these nutrients through commercial fertilizer use.

Now, what are commercial fertilizers? By definition, commercial fertilizers are products used primarily for their plant nutrient con-

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[1] See p. 145 for the prepared statement of Mr. Myers.

tent. In the case of nitrogen fertilizers, the nutrient is produced by combining nitrogen from the air and hydrogen, which is derived largely from hydrocarbons such as natural gas.

Phosphate and potash and most other nutrients are mined products, treated and refined for efficient use by agriculture. Their sale is regulated by State fertilizer control laws which require that fertilizers be labeled as to their guaranteed nutrient percentages.

Uniform methods are used to chemically determine these nutrient guarantees. Now, let us discuss the organic mystique. It has been popular in some circles to promote the use of so-called "organics" as healthier for the plants, resulting in more nutritious foods, and other catch phrases.

The facts should be examined very carefully before accepting such suggestions because despite efforts to promote "organic farming" as more helpful to plants or to those who eat the plants, the plants just cannot differentiate.

All the 12 nutrients which man applies to the soil for crop use enter the plants as an inorganic ion, regardless of whether the application is manure, legumes, plant residues, or commercial fertilizers.

With the exception of some use of foilage application, the nutrients mentioned previously enter plant roots via the soil solution. In other words, organic nutrient forms must first be converted to inorganic ions in the soil to be useful to the growing plant.

Commercial fertilizers are nutrient materials designed to maximize plant nutrient uptake in the most efficient manner by providing those nutrients in a form which is readily available to these plants.

Even though these facts have been known for more than a century, the misconception has still been nurtured that the use of organics, animal manures, sewage, compost, plant residues, and such produce more nutritious foods, more productive soils and, in reality, embrace "the natural way to farm."

These, Mr. Chairman, are false conceptions. Again, plant nutrients enter plants as inorganic ions, going through the soil solution, to the root surface, and then through the cell walls and membranes into the root.

Let us look at chart No. 1. In the past several years commercial fertilizers have provided about 20 million nutrient tons of nitrogen, phosphate and potash for crop production in the United States annually. Use of these commercial fertilizers accounts for 30 to 40 percent of our current crop production.

CHART 1

Feed Grain Production and Total U.S. Nutrient Use

	1960	1970	1980
Million Tons of Feed Grain Production	155.6	160.1	217.8
Million Tons of Nutrients	7.5	16.1	23.1

According to a report by the Council of Agricultural Science and Technology, there are approximately 50 million tons, dryweight, of animal manure available for farm use produced in the United States annually. The potential nutrient value of this 50 million tons, if produced in confinement, well protected from weather, and available in locations conveniently to apply to our crop land, is equivalent to the following fractions of nutrients applied in commercial fertilizers: one-twelfth of the amount of nitrogen fertilizers now applied; one-fifth of the amount of phosphate fertilizers; and, finally, one-fifth in commercial potash fertilizers.

Looking at chart No. 2, to provide nutrients for agriculture in the United States through animal manure as a replacement of commercial fertilizers would require increasing the number of animals on our farms by a factor of 5 to 12.

Such an option is clearly unrealistic, unless we can develop some magic feed for the animals themselves, additional acres on which to grow that feed, as well as develop a booming world market for resultant increase in U.S. beef, pork, and milk.

CHART 2

"Organic" vs. Commercial Fertilizer

50 Million Tons of Animal Manure = 1/7 of Nutrient Demand

2,000 lbs. Manure vs. 100 lbs. Nutrient

40,000 to 80,000 lbs. Manure vs. 200 lbs. Nitrogen

Now, let us look at charts 3 and 4. Other factors regarding animal wastes are worth mentioning. For example, it takes 1 ton of cow manure, well protected from weather elements to equal the nitrogen and phosphate and potash contained in only 100 pounds of 10–5–10 commercial fertilizer—a commercial fertilizer which today is considered very low in analysis in our industry and one rarely used on major crops.

To apply 200 pounds of N per acre—a rather typical application rate for commercial corn production today—approximately 20 tons of animal manure per acre would be needed, assuming it was applied under ideal conditions and there was no volatilization loss or escape of nitrogen in the atmosphere.

However, under usual farm conditions, significant nitrogen volatilization loss is likely for such applications. A more realistic estimate is that as much as 40 tons of manure per acre would be needed to provide the 200 pounds of nitrogen earlier referred to.

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CHART 3

Nitrogen–Phosphorus–Potassium

(10-5-10)

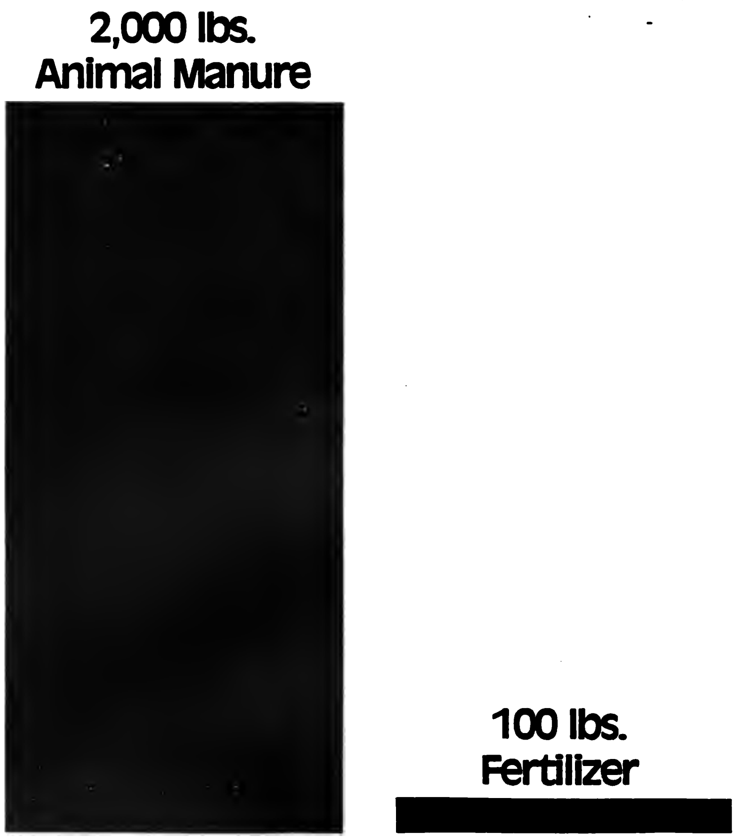
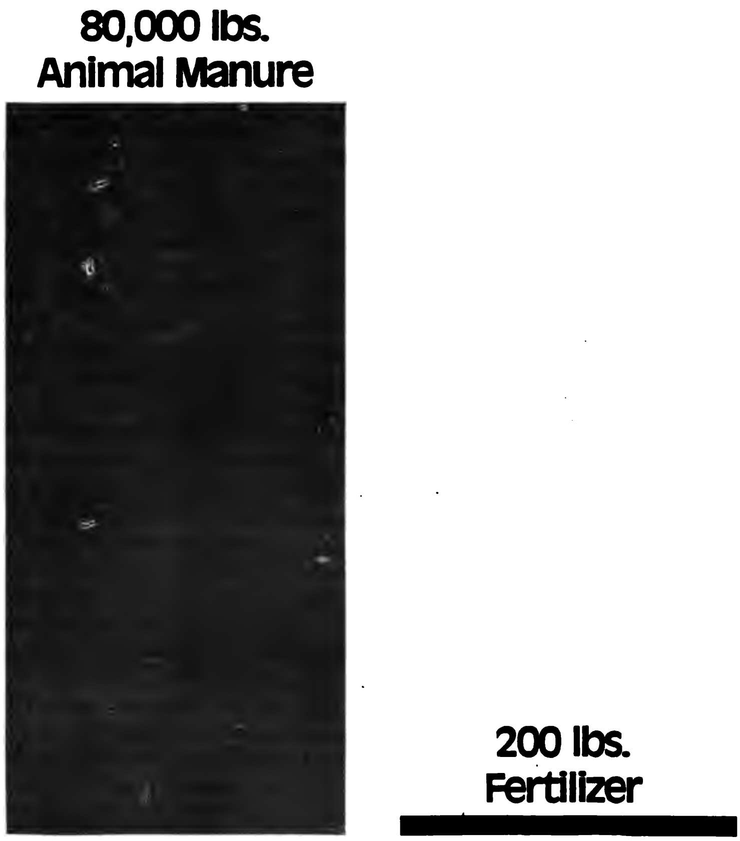


CHART 4

Per Acre Nitrogen Application

(For Average Corn Production)



Looking at chart No. 5, such factors clearly show that there is not enough animal manure, nor could we generate enough to sustain the levels of crop production necessary for our Nation's well-being.

I would like Dr. White now to explain this chart that we have on the board now.

Dr. WHITE. Mr. Chairman, within the Fertilizer Institute, I was elected to hike out one evening to the local Hechinger store and see what I could find in animal manure products. What we have illustrated on this chart is just what I found.

At a local store, I found a bag of processed, dried animal manure containing on the label, as Gary Myers indicated, the guaranteed percentage of nitrogen, phosphate, and potash products. What was on the label was 1-1-1. You add that up and you get three percentage points of nitrogen, phosphate and potash in that bag, dried and processed.

A 40-pound bag—I probably should have brought it today, but it was just too hot to lug that bag in, so we brought the chart.

Senator LEAHY. I should note for your sake that the committee will be able to overcome its disappointment at the bag not being in here. [Laughter.]

Mr. MYERS. We were going to let you carry it home.

Senator LEAHY. That is what I was afraid of. [Laughter.]

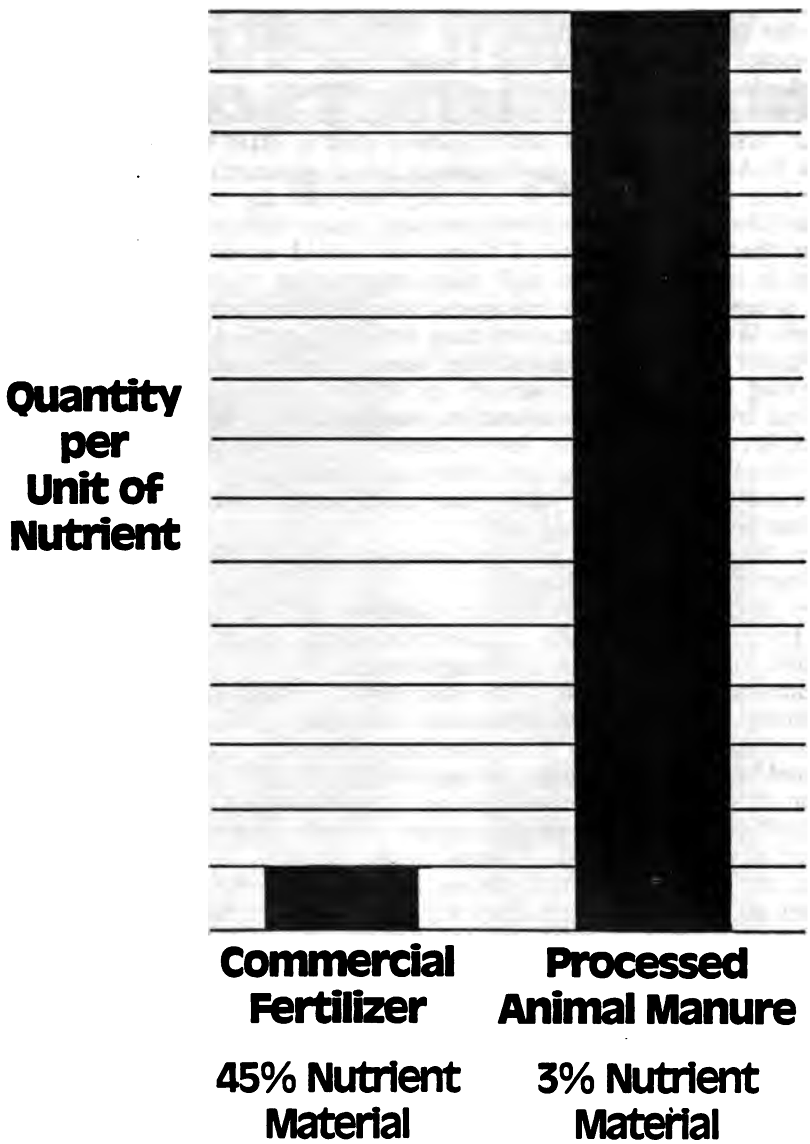
Go ahead, sir.

Dr. WHITE. Mr. Chairman, the point on the graph illustrates simply that it takes about 15 truckloads, 15 bags, or whatever unit you want to make, of this dried animal manure product to provide the same quantity of nutrients you would get in one unit of commercial fertilizer.

This is what that graph shows: one unit of commercial fertilizer, 15 units of this processed animal manure.

Senator LEAHY. Are you saying that you do not think organic farming systems should be researched as one of a number of agricultural alternatives, though? You are not saying that, are you?

CHART 5


Quantity
per
Unit of
Nutrient
Commercial
Fertilizer
45% Nutrient
Material
Processed
Animal Manure
3% Nutrient
Material

Dr. WHITE. No; we are not saying that, Mr. Chairman. All we are trying to illustrate here is the magnitude of the volume of these products that would be required to provide equivalent plant nutrients for crop production.

Senator LEAHY. Mr. Myers, I want to ask you this same question. What do you think about organic farming systems being researched as one of any number of agricultural alternatives?

Mr. MYERS. I guess I could answer that a little better. We have been looking into this and quite a bit of research has been done over the years. Now, it is not very easy to dig out because it is spread through many publications and many different libraries.

On that specific point, I think we would agree with you that there is a real need to pull this information together. We think that is necessary before we spend this $10.5 million for further research. We think the answers may already be there.

Senator LEAHY. When you are researching agricultural matters, referring to this particular one or anything else, do you find the general concept of demonstration projects to be a good one?

Mr. MYERS. Yes; we do. As you know, in the history of USDA and their field studies, it has been very successful.

Senator LEAHY. You have done that within your own industry, for that matter, have you not?

Mr. MYERS. Yes; that is right, considerably.

Senator LEAHY. Go ahead.

Mr. MYERS. Let me finish up. Addressing finding No. 4 in your bill, I would like to really discuss this a little more, and it has been alluded to already in the opening statements.

Addressing finding No 4, the statement is made that agricultural practices are needlessly dependent on limited global reserves of oil and natural gas. Aside from the fact that such a statement could be made on most segments of our society, depending on one's definition of "need," the presumption in this finding is that a viable alternative exists that would ensure a continued abundant supply of food at a lower level of energy consumption.

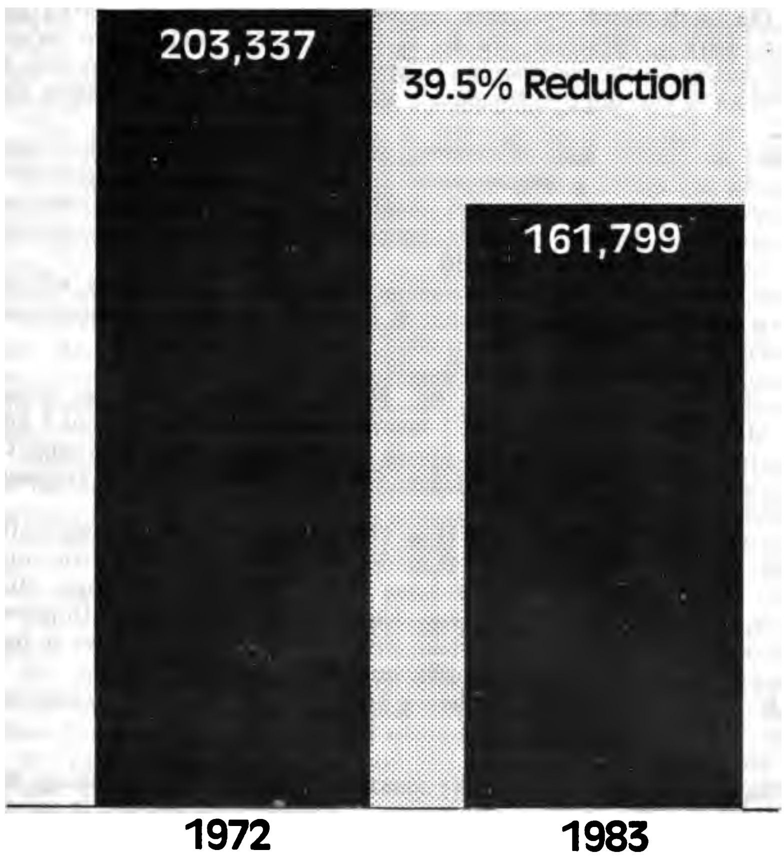
No such dramatic alternative has been made evident to the American people. I would dare say that every farmer considers his operation an energy-intensive business. Insofar as the fertilizer industry is concerned, our production processes do require substantial amounts of energy.

Yet, we have moved in a responsible manner to cut that consumption level and still produce more plant nutrients more efficiently. For example, comparing with the Department of Energy's base year for such figures, 1972, our industry in 1983 posted a 39-percent improvement in energy use efficiency in fertilizer production. (See chart No. 6.)

CHART 6

Fertilizer Industry Energy Consumption

(Billion BTUs)



This means that our industry's use of energy has declined by 39 percent for each ton of product since the year 1972. This measure of performance hardly signals an increasing energy dependence or, as the findings state, a heightened economic vulnerability.

Mr. Chairman, in summary I must repeat that the basic thrust of this bill presumes that, one, current agricultural productivity is insufficient; current agricultural systems cannot endure and remain profitable over the long term; current agricultural practices are wasteful of natural resources; current agricultural research is inadequate to address these concerns; and, No. 5 new funding of alternative farming methods will produce responses to the above concerns.

These are the premises and inferences which we just cannot support. On each point, we urge extreme examination in justifying this legislation. However, we do, as I mentioned earlier, see value to the charge to the Secretary of Agriculture contained in section 4 to conduct a thorough information study, and we support such an effort.

There is a great deal of existing and related research underway on practices involving conservation, energy use, cropping productivity, uses of manures and crop residues, on small farm economic profitability. A special effort to consolidate, analyze, and evaluate that research would be valuable.

Thus, we would support necessary funding for such an effort. Then a decision on further research needs or research implementation could be made on a well-studied, intelligent basis.

Thank you very much, Mr. Chairman.

Senator LEAHY. Thank you, Mr. Myers. I have no further questions other than the ones that I interjected during that. What I am going to do is recess now for about 15 minutes. I am supposed to make a quorum briefly in another committee over in the Dirksen Building.

One of the explanations for that $100 million Taj Mahal we built ourselves down the way was that we would have all our committees in one building. We now have them in three buildings, plus the Capitol. This is, if not to improve efficiency, to at least improve the muscle tone of Senators while we go around passing laws to tell American industry how to be efficient.

I thank you very much for being here. We will stand in recess for about 15 minutes.

[A recess was taken.]

Senator LEAHY. Back to the hearing. I apologize for being delayed. Unfortunately, the chairman of the committee also is off on other matters. One of the problems is that each one of us is supposed to be in five different places.

Our next witness will be Dr. Garth Youngberg, the director of the Institute for Alternative Agriculture, Greenbelt, MD. Then we will go on down through as many of the others as we are able to do prior to the time we have to adjourn to go on to the floor.

Doctor, it is good to see you again.

STATEMENT OF DR. I. GARTH YOUNGBERG, EXECUTIVE DIRECTOR, INSTITUTE FOR ALTERNATIVE AGRICULTURE

Dr. YOUNGBERG. It is nice to see you, Senator. I also have a fairly lengthy statement, but I have tried to condense my remarks so that I can stay within the 5-minute period that you had requested.

Senator LEAHY. The full statement will, of course, be made part of the record.[1]

Dr. YOUNGBERG. Senator Leahy, members of the subcommittee, I am Garth Youngberg, executive director of the Institute for Alternative Agriculture, a private, nonprofit agricultural research and education institute with offices in Greenbelt, MD.

The institute, which is governed by an 11-member, grassroots board of directors, seeks to advance, through the development of research and education programs, systems of food and fiber production that are economically profitable, resource conserving, environmentally sound, and sustainable in the long term.

The institute is very grateful to the subcommittee for the opportunity to testify on the Agricultural Productivity Act of 1983.

Because the general intent of S. 1128 is to develop sound educational and research programs in the area of alternative, low chemical agriculture, the institute is supportive of this proposed legislation. We believe it addresses a number of important needs and concerns which I will discuss very briefly.

One of these has to do with misinformation and negative symbolism. Alternative farming systems continue to be overlooked, in our judgment, by most conventional agriculturalists in part because of the lack of credible information or misinformation on these farming systems.

Many conventional agricultural scientists and farmers continue to believe that only hippies, health food fadists and displaced urbanites practice alternative agriculture.

Senator LEAHY. And they all come to Vermont to do it. [Laughter.]

Go ahead.

Dr. YOUNGBERG. I have been to Vermont and enjoyed it very much.

We believe that scientifically credible eduational and research programs provide one of the most important vehicles for correcting these kinds of unfortunate and misleading stereotypes.

In this regard, it is important that at least some of these programs be conducted by so-called establishment scientists. Most conventional farmers continue to be heavily influenced by the research and education agendas of the USDA and the land grant universities.

To its credit, S. 1128 would make it possible for some of these institutions to be involved in the development of modest programs of research and education on biological farming systems.

The second area has to do with informational needs. Increasingly, biological farmers who may simply wish to improve their systems, and conventional farmers who are interested in switching to

[1] See p. 156 for the prepared statement of Dr. Youngberg.

alternative farming approaches, are beginning to seek out reliable information on biological farming.

For example, a large proportion of the attendees at the highly successful Alternative Agriculture Field Day, now held annually at the University of Nebraska, are conventional farmers. These farmers are interested in learning how legume-based crop rotations, green manure crops, improved manure and crop residue management, and so on, might help to reduce the rising costs of production and simultaneously control soil erosion and the pollution of underground water supplies caused in part by excessive fertilization, pesticide use and monocultural cropping systems.

In the short time that the institute has been in operation, we have received scores of inquiries about these same kinds of technologies and concerns. Farmers are particularly interested in the economic benefits and costs associated with alternative agricultural production technologies.

Paraphrasing for a moment, the following examples are illustrative of the kinds of questions we receive. In order to save time, I will only mention a few here.

Can we make money farming with alternative methods? How can I control weeds without herbicides? If I want to shift to organic methods, what do I do first? How fast can I move? Will I have special equipment needs—tillage, residue management?

What are the best cover and green manure crops for my area? Where do these crops fit into the rotation and how long should they be allowed to grow for maximum benefit? What is the best way to handle manure? Should I compost it? Why? Must I have animal units to farm organically? What would be the best crop rotation for this area?

While a substantial amount of relevant information in these areas does exist, it is scattered and incomplete. Much of it also may be dated due to various technological advances. In any case, farmers complain that they are unable to get answers to these and similar questions from their local universities and extension services. I have heard of these difficulties repeatedly and often over the last several years.

The third area has to do with research opportunities and needs. Over the past several years it has become increasingly clear that a growing number of agricultural scientists are motivated to conduct research on alternative farming systems.

My written testimony contains a number of examples of recent scientific meetings and events that underscore this trend. As a matter of fact, I have just returned from a 3-day symposium held at Michigan State University, entitled "Sustainable Agriculture and Integrated Farming Systems."

We are so convinced at the institute of the need and opportunity to develop scientific materials in this area that we are planning to begin publishing in mid-1985 a professional, refereed journal that will follow all of the professional protocols of peer review, and so forth, devoted to alternative agricultural approaches.

Roughly 25 of this Nation's leading agricultural scientists will comprise the journal's editorial board. Clearly, the opportunity for assembling top scientists to conduct the research envisioned in this legislation is excellent. In this regard, S. 1128 could provide an im-

portant catalyst for the development of interdisciplinary, systems-oriented research on biological agriculture.

The need for conducting research and education programs in this area has been documented in a number of scientific studies and reports which are cited in my testimony.

In closing, I would just like to urge you and the other members of the subcommittee to consider and then adopt S. 1128. This bill could help our Nation's farmers begin to wean themselves away from their heavy dependence upon increasingly expensive fossil fuel-based production inputs.

In this sense, this legislation directly addresses many of the needs of a broad cross section of American agriculture—lower operating costs, resource conservation, environmental protection, and long-term sustainable food production. We urge the subcommittee to continue working for these goals.

Thank you.

Senator LEAHY. Thank you. Doctor, I want to thank you again for your trip to Vermont last year for the NOFA meeting.

In your full statement, you have indicated a growing interest in organic farming among farmers and researchers around this country. As I recall, you said similar things last year. Would you care to elaborate on the reasons for this?

Dr. YOUNGBERG. Well, as I have alluded to in the statement, the reasons for the growing interest—and, of course, it varies from one part of the country to another and one farmer to another. But in generalizing here a bit, it has an awful lot to do with the desire to reduce production costs.

We hear farmers saying that they just cannot continue to spend as much as they are for fertilizers and pesticides and stay in business. So this seems to be one of the new, dominant themes. I am not sure how new it is, but it is certainly a dominant theme.

The others have to do with a growing concern about soil erosion, water pollution and health—their own personal health in some cases, and the health of their farm workers. These would be some of the principal reasons, and we hear this repeatedly.

Senator LEAHY. Did you not find at the NOFA meetings some pretty solid, both-feet-on-the-ground types of people talking about this?

Dr. YOUNGBERG. Very definitely, and not only at the NOFA meeting, but I have been privileged in the past several years to attend perhaps 30 of these kinds of meetings, producer meetings around the country. And I am always impressed with the farmers that are there and the kind of agriculture they are doing.

Senator LEAHY. They are not all some kind of a stereotype, crunchy granola——

Dr. YOUNGBERG. Well, there may be some granola there, but that is not a problem as far as I am concerned. There is great diversity in this movement, as you know, Senator, and I am impressed as I go around the country at this diversity.

In other words, the interest ranges from small farmers to very large farmers in many cases. It depends on what part of the country you are in.

Senator LEAHY. Well, I appreciate the work you do in this, and you have been sort of a voice in the wilderness for years and I appreciate the fact that you have been there very, very much.

Dr. YOUNGBERG. Thank you.

Senator LEAHY. Thank you, Doctor. I think we ought to leave the record open. There may be questions from some of the other members, and at the end of this, based on the testimony we hear from the rest, I may also have some. Thank you.

[The following letter was subsequently received by the subcommittee:]

INSTITUTE FOR ALTERNATIVE AGRICULTURE, INC.,
Greenbelt, MD, July 16, 1984.

Hon. PATRICK J. LEAHY,
U.S. Senate,
Washington, DC.

DEAR SENATOR LEAHY: Thank you for your recent letter pertaining to the Agricultural Productivity Act of 1983, S. 1128. I am most happy to be able to respond to your question.

In my judgment, farmers are not able, in most cases, to obtain answers to the kinds of questions cited in my testimony on June 14th. One of the dominant themes with respect to alternative agriculture over the past 30 years has been the inability of organic practitioners to obtain satisfactory answers to these kinds of production and management problems. To make matters worse, they are often greeted with a certain sense of ridicule for even asking about alternatives to chemical approaches. While this is not universally true (there are a number of scientists and extension agents who have shown considerable interest in alternative agriculture), it remains a serious impediment to the wider-scale acceptance and adoption of alternative approaches. The lack of integrated, systems-oriented alternative management information is even more notably absent in most cases.

Please let me know if I can be of further assistance.

Sincerely,

I. GARTH YOUNGBERG, PH.D.,
Executive Director.

Senator LEAHY. Next we have a panel of Bruce Hawley, Sara Ebenreck, Paul Markowitz, and Robert Rodale. Mr. Markowitz, why do you not come on over here and we will just work down through? As you can see, I am going alphabetically, starting with Vermont. [Laughter.]

Let me make sure I have got where everybody is. Mr. Markowitz, I know. Ms. Ebenreck?

Ms. EBENRECK. I am with the National Association of Conservation Districts as director of communications.

Senator LEAHY. Did I pronounce your name correctly?

Ms. EBENRECK. Yes, sir.

Senator LEAHY. Sir?

Mr. HAWLEY. I am Bruce Hawley.

Mr. RODALE. Robert Rodale.

Senator LEAHY. It is good to have you all here. What I will do is start with one more panel on here, and why do we not start in the order we have it on the list, with Mr. Hawley first and work on down?

STATEMENT OF BRUCE HAWLEY, ASSISTANT DIRECTOR, WASHINGTON OFFICE, AMERICAN FARM BUREAU FEDERATION

Mr. HAWLEY. Thank you, Senator, and good morning. I am Bruce Hawley, assistant director of the Washington office of the American Farm Bureau Federation.

The American Farm Bureau is a general farm organization representing 48 States and Puerto Rico. Farm Bureau membership exceeds 3.2 million member families. Farm Bureau policy for years has been strongly in support of agricultural research.

The policy of the Farm Bureau, adopted at our most recent annual meeting in January 1984 in Orlando, says, in pertinent part, "Expanded research is needed to improve the productivity of crops in terms of yield per acre and nutritional value." The policy additionally says:

> We strongly support continued research to find solutions to national energy problems through the use of agricultural products; better solutions to agriculture's environmental concerns; acceptable controls for diseases, noxious weeds, insects; and new alternative crops.

The Agricultural Productivity Act of 1983 is an overly timid step in the right direction. Senator, it is unusual for us to find you providing leadership that we consider overly timid in an effort to solve problems. [Laughter.]

The bill correctly states, in our opinion, that a highly productive agricultural system which includes sound conservation practices is essential to ensure long-term agricultural sustainability and profitability.

Agricultural research and technology transfer activities at USDA have contributed and continue to play an important role. The bill references the cost of energy in an intensive agricultural system, recognizes the importance of public funding of agricultural research, and supports an expanded cooperative extension program. These are certainly laudable and supportable goals.

However, we suggest that the bill falls far short of supporting these purposes. The bill proposes to spend $2.1 million a year for each of the next 5 years, evaluating what farmers are currently doing.

We suggest that this approach is an inadequate response to the important needs of today's modern and dynamic agricultural production system.

As this committee is aware, agricultural chemicals, including fertilizers and pesticides, now rank fourth as an expense item in agriculture, behind feed purchased, equipment repair and operation, and capital consumption items.

Agricultural chemicals are the most rapidly rising expense on the input side of production agriculture. A considerable share of this increase is tied to the increased cost of petroleum. However, the research to develop and clear new products is pushing pesticides more and more into a high-cost bracket.

Farmers spend between $9 and $10 billion annually—that is with a "b"—$9 and $10 billion annually for fertilizer and lime, and about $3.5 billion for pesticides. Alternative technologies that would reduce the necessity of depending on these chemicals or replace the need for them entirely in some instances would obviously be of great benefit to the agricultural producer, consumer, and the environment.

Nearly half the pesticides applied in production agriculture are used on the crops of corn and cotton. Three-fourths of the pesticides used on corn are in the form of herbicides, and nearly three-fourths of the pesticides used on cotton are insecticides.

It would seem appropriate that research should be focused primarily on the reduction of the need of pesticides in these two categories as a primary mechanism for reducing total environmental pesticide exposure.

Research is currently underway in the Delta Branch Experiment Station in Stoneville, MS, to develop a nonchemical control for the tobacco budworm which, as you know, is an important cotton pest problem. Researchers have crossed two variations of the tobacco budworm species, one that feeds on the cotton plant and another that feeds only on groundcherry.

Upon crossing these species, scientists have found the moths resulting from this fertile cross have been unable to reproduce when the F1 generation was subsequently mated. The males of the cross were sterile.

Further, they discovered that when the females of the second generation were crossed back to fertile tobacco budworm males, the sterility of the male offspring continued through successive backcross generations.

The potential for control of the tobacco budworm as a major pest problem in cotton is obvious from this research. The point is we have only scratched the surface of the things that can be done to control cotton pest problems through genetic manipulation of insect species or the crop itself.

Cornell University has undertaken some fascinating research to transmit to corn plants of today's high productive potential an insect-resistant characteristic, making the leaves of the corn plant unpalatable and/or toxic to certain insect pest species.

This work is being undertaken through the utilization of gene splicing to bring certain characteristics of South American vegetation into hybrid corn plants. It is a process that would have been virtually impossible prior to the advent of the modern biogenetic manipulation techniques.

There are a number of examples, some of which have already been spoken to this morning, of attempts to create a nitrogen-fixing bacteria or other method of nitrogen fixation for corn and wheat.

As this committee is aware, more fertilizer is applied to commercial corn in the United States than any other single commodity produced. If fertilizer fixation could be genetically incorporated into corn plants, tremendous reductions in agricultural costs of production, tremendous advancements in Third World corn production levels, and tremendous reductions in potential surface and ground water contamination could be achieved.

Although the research to date has not borne great promise, that ought not discourage us from pursuing these potentially important avenues of enhanced production technology. Increased use of gene splicing and similar genetic manipulation might very well produce a breakthrough of virtually unprecedented magnitude in terms of worldwide productive capacity.

The University of Georgia has had underway for a number of years research in pheromonal control for the imported fire ant. This pest, which has infested 250 million acres of the southeastern United States, has been of increasing cost and consequence to agriculture as well as to residents of that area.

The most effective pesticide control techniques available to agriculture have been denied for future use, and continued problems seem to occur with the existing products. Pheromonal control is not yet commercially available, but the research must be continued. The Farm Bureau perceives this research initiative to be promising enough and important enough that we have shared in the funding of this program for the past several years.

The opportunities to do better in terms of our pest control programs and our crop nutrition programs in agriculture are enormous. We urge this committee to take aggressive action in this regard.

With due respect, the bill that is pending before this committee, S. 1128, is a timid toe in the water at a time when we would encourage Congress to jump in and swim. Rather than encourage the Secretary of Agriculture to do 12 pilot projects of studying what is being done in the field by working farmers today, we encourage instead an amendment in the nature of a substitute that would direct the $2.1 million each year for the next 5 years contemplated by this bill be specifically lined into the land grant universities to fund research into genetic manipulation techniques for agricultural crops that would reduce dependence on pesticides and fertilizers.

Second, we would recommend that the substitute legislation include a congressional mandate for a USDA-coordinated study of the constraints of various Federal laws to enhance agricultural production techniques.

This study could look at the negative impacts of ground water protection and surface water quality protection legislation on the use of municipal sludge as an agricultural soil enhancer, at the additional cost of pesticide development imposed by Federal regulatory systems to the extent it is precluding the development of pheromones and other biorational pesticides, and an evaluation of a mechanism to provide some Federal coordination of the various research efforts currently being undertaken in the biogenetics engineering field.

It is our understanding that much of this research is being held so close to the vest that there may be duplication of research ventures underway in various institutions because of a fear of loss of leadership in the area through an information-sharing program.

Senator LEAHY. Assuming we wrote the legislation precisely that way, considering the open opposition and almost animosity on the part of the USDA toward what we all admit is a modest step, to do what you are suggesting, do you think that we would even be able to get the thing onto the floor for a vote, to say nothing about getting it out of committee, keeping in mind that we have to deal with the art of the possible?

We have been pushing and pushing and pushing on the USDA for several years and cannot even get them to accept—in fact, we have open opposition from them on this. There was a suggestion made today that it was too expensive because it is 0.002 percent of the R&D budget.

It is 0.006 percent of the cost of the PIK Program, or whatever it is. But somehow it is going to break the bank. What do you do? Do you take something like this, which is admittedly modest but at least has been able to get a bipartisan group of supporters and has

a possibility of passing, or do we go with something significantly more which has no possibility whatsoever?

Mr. HAWLEY. Well, given the position of the administration as you have characterized it, it is no harder to pass a better bill than to pass the existing legislation.

Senator LEAHY. You have discovered something in the Senate that I have not. It has escaped my notice for the past 10 years, but I will take your word for it. If it can be done, I would be happy to introduce the more extensive piece of legislation.

Mr. HAWLEY. Senator, I certainly have nowhere near the expertise that you and your colleagues do in what the Senate is capable of. But in my 11 years in this town, I have seen on numerous occasions Congress exercise its will independent of the thoughts of the administration when, in the collective judgment of Congress, it was perceived to be the right way to go.

The administration advises to the Congress, but Congress legislates.

Senator LEAHY. I understand, and I think there are at least one or two instances where I have seen that happen during the past 10 years. I do know the situation we have now, and I do know the number of days left within the session.

I will be going shortly to the floor with an amendment which I think is one most people should agree to, and that is we ought to at least continue current efforts at arms control. Both countries have the ability to blow each other up, both the United States and the Soviet Union, and the rest of the world along with them.

We will probably spend 5, 6, 7 hours debating that, with strong opposition from the administration. Now, I mention that only because sometimes what might seem like a good idea can well get sidetracked.

I am also aware that in some instances, yes, the Senate may well rise above, and the House may suddenly rise above and say this is a matter of such overwhelming national importance that we can ram it through.

I am not sure, if we were to ask the leaders of both parties in the House and the Senate to give us their short list of those items that they would be able to go to the Congress and say this is a matter of such overwhelming national importance that we could short circuit the normal steps, we could bypass opposition of the administration and go forward with it, that organic farming would be on that short list.

I do not say it sarcastically because I do not mean it to be, but I happen to think that when we look at some of these things there should be a few like organic farming on the short list because I do think they are important to the country.

I do think, however, that we are getting into almost stalemated situation in the Congress where good things do not seem to go anywhere.

Mr. HAWLEY. I agree that the concepts that we are talking about here are important farmers. I am not shocked that what have been characterized as good, both-feet-on-the-ground farmers show up at the meetings that are being held on this subject around the country. Of course they are.

Farmers are always receptive to any new ideas that may be cost efficient and practical. We did not say it was going to be easy to pass your proposal or what we are offering as an alternative. It is not going to be easy to do what you want to do in arms control either.

If it is important enough to deserve your attention, it is important enough to pursue for the length of time that it takes to make it happen. Maybe we cannot pass this this year, but we should try to do as good a job as we can.

Senator LEAHY. I see, and I find your testimony valuable in suggesting alternatives. I would not want the impression left, however, that it is an easy thing to pass. But I think we all agree it is a good concept in whatever form over the kind of opposition that we are facing.

Mr. HAWLEY. Yes, sir.

Senator LEAHY. And that is the difficult thing. We discussed it at some length last year at the conference that Dr. Youngberg and I were talking about earlier that was in Vermont.

Paul, you were at that conference, too, were you not?

Mr. MARKOWITZ. I missed that conference.

Mr. HAWLEY. I have concluded my statement. I would like to submit for the record, however, a report prepared by GIFAP,[1] which is an international consortium of pest control officials, dealing with some well documented, heavily footnoted studies in the European Community of various technologies used in organic farming, responding specifically to several of the arguments, questions and concerns that are raised in this debate, which, as you indicated, has been somewhat heavily polarized over the years.

Senator LEAHY. Thank you. I appreciate that because I think this is one of those few areas where the European agricultural market has gone way ahead of us, so that will be well worthwhile.

I do appreciate your testimony. I do not want to leave the impression that I do not; I very much do.

Mr. HAWLEY. Thank you.

Senator LEAHY. Ms. Ebenreck?

STATEMENT OF SARA EBENRECK, DIRECTOR OF COMMUNICATIONS, NATIONAL ASSOCIATION OF CONSERVATION DISTRICTS

Ms. EBENRECK. Mr. Chairman, I am Sara Ebenreck, director of communications for the National Association of Conservation Districts. Our association, as you probably know, represents about 3,000 soil and water conservation districts in every State of the country and the Virgin Islands, Puerto Rico, and the District of Columbia.

Conservation districts cover virtually all of the agricultural land in our Nation, and work with over 2.5 million landowner cooperators.

In brief, we support this legislation and urge its passage. Our association and our member districts have been long involved in support of farming practices which maintain long-term productivity on

[1] The report referred to by Mr. Hawley has been retained in the committee files.

the land. We have supported other research which will assist landowners in achieving that goal.

We do have a special project, the conservation tillage information center, which is now encouraging exchange of information on new crop residue management and tillage systems which build soil productivity while reducing labor and some of the costs of inputs into farm production. And I might say that there has been strong national interest from every sector of the country in that kind of information.

Most of our members are conventional farmers in the sense that they do use chemical fertilizers and pesticides as they see them needed. They are conventional farmers who are deeply concerned with ways in which soil and water conservation can be achieved while still achieving the yields that keep them in business.

Many of them use the kinds of conservation methods referred to in this bill—conservation tillage, crop rotations and cover crops. Most of them are constantly on the outlook for any method, new, old or improved, that will make economic sense to them and improve their conservation system and the productivity of their land.

NACD thinks that the research described in this bill could make one solid contribution to the effort of building agricultural systems that are both economical and resource conserving.

One of the major things that we have learned at our conservation tillage information center in this past year is that farmers learn best through demonstration projects. They want to know what a new system can do on their land and whether they can handle the management skills needed to make it successful.

The onfarm pilot research programs proposed by this bill would take a solid step in the direction of providing that information to farmers to see what methods can and cannot do in every region of the country.

I might add here that I envision down the road the possibility of that growing to the kind of small, onfarm demonstration plots that we are now using in the conservation tillage area.

Because of our strong interest in resource conservation, we are pleased to note that a criterion for the pilot research projects in this bill is that the owner or operator of the farm must have a conservation plan approved by and on file with their conservation district.

We think that that working arrangement will encourage maximum conservation in the efforts proposed here, and also facilitate the exchange of information between those research programs and our conservation network.

Further, because of our experience that cooperative efforts in conservation are essential in achieving maximum results, we are pleased that the bill before you ensure that the pilot projects be designed and carried out in coordination with the major agricultural agencies and organizations. We also encourage the fast dissemination of data gathered through these projects through the same kind of cooperative effort.

I might say again that our Conservation Tillage Information Center is a national clearinghouse. Interagency cooperation has been strong and effective, and it is that kind of a model that we are thinking of here.

Finally, we think that the effort to complete an inventory on existing information related to low-energy systems of agriculture will be useful. In particular, locating the gaps of information needed to achieve the purposes of this act would be most helpful.

In conclusion, then, NACD supports this legislation. We think that all provisions of the bill before us, in fact, could be carried out under existing USDA authorities. But we also think that passage of the legislation would make clear to the Department the support of Congress and a broad constituency of American farmers and other citizens for the kind of resource conserving farm systems that can ensure long-term agricultural sustainability.

Thank you for the opportunity to present our views.

Senator LEAHY. Thank you. Do you feel that there will be benefits from this research in terms of soil conservation?

Ms. EBENRECK. Yes, we do, and our members do; they have expressed interest in that.

Senator LEAHY. I have heard from some of them and I was glad of that because obviously that is one of the areas of concern. It was one of the reasons why some of the Senators from the Western States and Midwestern States have expressed interest in the legislation.

Mr. Markowitz, let us go with you; give us the view from Vermont. Of course, that will not bias me in any way, shape or manner, you understand, unless you are opposed to it. [Laughter.]

Mr. MARKOWITZ. I would not do that to you.

I am still getting used to the heat; it is a little bit different than up north.

Senator LEAHY. Can I tell you something? You never get used to the heat. I went to law school here and have been here in the Senate 10 years, and what I look forward to in the summer is, as soon as the weekend comes, to get on that plane and head back home. You never get used to it.

STATEMENT OF PAUL MARKOWITZ, NATURAL ORGANIC FARMERS ASSOCIATION, BURLINGTON, VT

Mr. MARKOWITZ. I would like to start off. My name is Paul Markowitz from Burlington, VT. I am a member of the Natural Organic Farmers Association, and that is who I am submitting the testimony of.

NOFA is a nonprofit membership association of farmers, gardeners, agricultural researchers, educators, advocates, and consumers who have been working together since 1971 to develop practical solutions to strengthen Vermont's agriculture. The organization has over 500 members in Vermont and is allied with NOFA chapters in other Northeastern States.

NOFA has been working at the forefront of the organic farming movement for 13 years. A number of our members are commercial organic farmers who have been developing farming practices which maintain natural soil ecology, build soil fertility through crop rotations and the use of animal and green manures, and control diseases, insects, and weeds without using agricultural chemicals.

Through its publications, educational programs, and conferences, NOFA fosters information sharing among farmers and other grow-

ers, and also provides technical assistance for farmers converting to organic methods. The organization has worked to provide a framework and funding for scientifically validated onfarm research directed toward organic producers.

Because of our deep concern and involvement with the continuing development of viable organic agricultural practices, we are very grateful and we welcome the opportunity to share our views on the Agricultural Productivity Act of 1983.

We are here to offer our qualified support for this bill. Our support comes from the knowledge of the urgent need to develop and implement agricultural practices which contribute to current and future agricultural productivity.

Without reform, present agricultural systems will lead to a serious decline in productivity and consequent economic and social duress. Incidence of diseases related to ingestion of injurious chemical residues and/or nutritionally unbalanced foods will also rise. Reform must be swift and certain.

The Agricultural Productivity Act of 1983 is laudatory in its attempts to support development of transitional methods between conventional agricultural practices and more healthful and sustainable systems.

Structuring research to be conducted on working farms is also wise. Farming methods must be tested and demonstrated within ordinary situations, and it is certainly time that sustainable and/or organic systems are recognized as valid. It is no secret that organic farmers and their advocates have long been regarded as more than slightly crazy.

Even New Yorker magazine carries the odd cartoon about them: Two old farmers looking at a weedy field and one says to the other, "It must be organic." But the fact is our farmers are producing high-quality goods at reasonable prices, using practices which conserve the land for a continuing food source. Perhaps this bill is a first step toward widespread recognition of the contribution that organic practices can make to American farmland and its dependents.

NOFA has several additional comments for the record. Transition is a long process, and a larger percentage of USDA research and education money must be allocated immediately to stave off the crippling effects of further environmental degradation.

We would recommend a year-by-year expansion of transitional research and implementation efforts until each farming region and enterprise is well represented.

Second, we believe the literature search provisions of the bill are worthwhile. While a great deal of written information is certainly available, our experience suggests that an equally large body of information is spread from farmer to farmer without benefit of publication.

Because many agricultural researchers and extension agents to this point have been disinterested, little of this farmer-to-farmer information has been passed on to them. Therefore, we strongly support the initiation of a personal contact search among working organic or biological farmers and consulting groups who work with them.

Third, these biological farmers and the consulting groups who work with them would also prove invaluable to setting up the research called for in the bill. Farmers all across the country have been working on transitional techniques for many years and have found varied solutions to some of the same problems. The people who know the most about transition are the farmers who have been practicing it.

We are concerned that the onus for the development of the research is placed on the State and Federal agricultural system. Few researchers within this system are experienced biological farmers. In order to conduct this research efficiently, they must educate themselves.

It would make a great deal of sense, we feel, to include practicing organic farmers, consultants, and researchers on both a coordination advisory board and smaller boards attached to the research effort.

In the long run, this will cut costs appreciably. These people already know of many workable systems as well as areas of serious information gaps and research needs. They have completed their basic training through direct experience and are ready to contribute to our knowledge about practical and healthful agricultural systems.

Mr. Chairman, NOFA urges passage of the bill. We want to also strongly urge the committee to continue to work toward adequate funding for research on transitional and organic methods, and to include experienced organic farmers, researchers, and educators in the research and education process.

I appreciate the opportunity to be here.

Senator LEAHY. Let me ask the panel the one parochial question I will ask today. What would you say is the state of organic farming in Vermont? Is it growing, declining, or stable, and why?

Mr. MARKOWITZ. Well, I would say it is on the increase. Of our 500 members right now, approximately 250 of those are organic farmers that have joined the organization. We have currently started a certification program, of which 20 have asked to be certified and it will probably occur by the end of the year.

I would say there are several reasons—I will list two—why I think organic farming is on the increase. The first one, which was mentioned earlier, is the fact of capital costs. I believe and NOFA believes that the rising costs of traditional agricultural methods—use of pesticides and chemical fertilizers—is putting a lot of farmers out of business and making farming an uneconomical enterprise.

I would say, second, that aside from the purely economic benefits, there is the whole aspect of health. I think there is a lot of concern out there for the use of pesticides and the movement along the food chain into our own bodies and what that effect is. I think from a purely healthful point of view, that is a concern.

Senator LEAHY. We will go with Robert Rodale.

STATEMENT OF ROBERT RODALE, PRESIDENT, REGENERATIVE AGRICULTURE ASSOCIATION, AND CHAIRMAN, RODALE PRESS, EMMAUS, PA

Mr. RODALE. Thank you. My name is Robert Rodale. I am president of the Regenerative Agriculture Association and chairman of Rodale Press.

The productivity of American agriculture, in my opinion, needs to be examined and redirected through the establishment of new research directives. The United States is now considered to have the most productive agriculture on Earth, but our agriculture is also a remarkably destructive system.

There is a sad tradeoff between productivity and destruction on the American farm today. Millions of tons of grain and other agricultural products, much of it unmarketable at reasonable prices, are being traded for tragic levels of soil loss, pervasive water and air pollution, burdensome levels of debt, weakening of rural communities, and the removal of millions of rural people from their homes.

So-called alternative systems of agriculture offer routes to the same productivity typical of American agriculture, but without its destructive side effects. Organic farming is the best known of these alternatives. Regenerative agriculture is organic farming with the more clearly stated goals of improving the farm resource base and restoring productivity potential already lost.

Research by USDA in organic regenerative agriculture is not a step back into the farming ideas of the 1930's, as is sometimes claimed by critics. It is a part of the needed movement of U.S. agricultural research into advanced technology.

Farmers have several sources of nutrients and pest control inputs. They can buy these inputs from suppliers off the farm or they can capture the same or similar needed substance from the locked-up reservoirs within the soil, air, and biological life forms.

Most American farmers now buy most inputs from off-farm suppliers and are encouraged to do that by much Government-sponsored research. Organic regenerative farmers use a sophisticated and truly scientific understanding of the renewable resources within their reach to produce as much or more, while maintaining or even improving environmental quality.

While the acts of doing that may appear mundane, when examined scientifically these systems are seen to be high technology in the true sense of that word. I will give some hard evidence from plot tests and onfarm analysis at our Rodale Research Center in Pennsylvania, which is typical of the kind of demonstration farms that USDA is being asked to set up.

First, we have achieved a 50-percent reduction in energy use per acre of corn. Second, the yields are 30 percent above State and county averages. Third, production costs are 10 percent to 30 percent lower than typical for the area.

Fourth, there is a marked reduction in the need for fertilizer inputs. Five, no pesticides are used. Six, soil erosion is reduced by over 50 percent. Seven, we have demonstrated that minimum tillage with no herbicides is possible.

These systems have much to offer, but they need more documentation, especially in other regions and different farm environments. The Agricultural Research Service of the USDA has made a step toward doing that by assigning a full-time scientist to the Rodale Research Center for computer modeling of integrated field crop systems using these methods. Our data, as well as other relevant data, will be used, and a network of laboratory and experiment station-based collaborators is being formed.

But there is, I should point out, a great need for data from additional farms in other environments to add to and validate the models from Rodale-based research.

The Agricultural Productivity Act of 1983 proposes farm-level studies to complement experiment station research. That adds a badly needed additional dimension to USDA agricultural research methods.

Even in the Third World, many examples of that research method have been in use for years. By enacting this legislation, the Senate would be causing U.S. agricultural research to catch up with methods now being used in many other countries.

Our Rodale Research Center has found the combination of whole-farm research and more controlled, replicated plot studies to be highly advantageous for identifying production problems, learning of significant interactions in the farm system, and testing new technologies by being able to insert them into the farming system.

I also feel that there is a clear national security dimension to stepped-up research in low-input agriculture. If a credit collapse or a shutoff of Persian Gulf oil supplies or other disruption of the world economic system would cut off farmers from supplies of inputs at reasonable cost, a rapid switch to organic regenerative methods would be needed.

More research into the methods of making that conversion are important to the security of the American economy, and therefore add an important dimension to our overall security.

Senator LEAHY. Thank you. I think that that last point especially cannot be overemphasized. One of the things that enhances our own security as a nation is that we are able to feed ourselves. There is no other really major power in the world that can totally do that. We cannot be starved out.

I certainly have no objection to the use of fertilizers or the use of nonorganic farming, but I would like to make sure that we are exploring all the alternatives, too, and are getting alternative bases.

We saw the mistake of putting our Nation primarily on an oil-based energy economy. We have to have alternative forms of energy. We have to have alternative forms of farming. And you are absolutely right in mentioning the security aspect; it is a very significant one.

We now find so much of our foreign policy and economic policy dictated by countries that we probably would not even know existed were it not for their oil supplies. I would hate to see us reach a point where other countries could exercise that same kind of power over us based on our food supplies.

So I thank you very much, all of you. Again, I apologize for the delays we incurred earlier. If it is any consolation, most of us left here around 1 o'clock this morning. Most of the Senators left at

around 1 o'clock this morning because of the debate on the floor, and we are now scheduled to go through, I understand, to something like 5 or 6 tomorrow morning.

Thank you very, very much, all of you.

[The following letter was subsequently received by the committee:]

RODALE PRESS, INC.,
Emmaus, PA, July 31, 1984.

Hon. PATRICK LEAHY,
U.S. Senate,
Washington, DC.

DEAR SENATOR LEAHY: In order to complete the Committee hearing record, I am enclosing Bob's responses to the two questions you asked in your letter of June 25.

Question 1. The question has been raised as to the suitablity of existing institutions for leading a research effort in organic agriculture. The research of these institutions have tended, historically, to lead us down the path of what you termed resource exploitive agriculture. Is it feasible for these institutions to now serve organic agriculture?

Response. There are what might be called islands of stewardship within the existing agricultural research institutions. These islands are peopled by researchers with a well-developed sense of responsibility both to the land and to the Americans who make their living on the land.

The proposed new research in organic and regenerative agriculture called for by S. 1128 could be based on an expansion of those islands. Our land grant institutions for agricultural research are not monolithic. Some of the staff are truly "out to lunch" with representatives of the agricultural input suppliers. But others are feasting inwardly on a love for the land and the people on it.

It is time for Congress to begin providing sustenance to the growing minority of researchers who are ready, willing and able to use their skills to regenerate American agriculture.

Question 2. Many people seem to think of organic agriculture as archaic agriculture, utilizing technologies from 40 to 50 years ago. Indeed, this seemed to be the view of certain of the witnesses at this hearing on S. 1128. Would you comment about modern organic farming technology and contrast it with the older technologies?

Response. Organic agriculture is the most scientific of all forms of farming—when judged from the perspective of all scientific disciplines. Conventional agriculture makes some sense from a purely chemical perspective. But organic/regenerative farming is a system designed also from a perspective of biology, ecology, sociology, geology, and soil science.

What about economics? When you look at today's organic farms and see how healthy their collective bottom line is, you begin to realize that perhaps these farmers know something that agricultural economists have not yet expressed clearly. That is, that a system which builds soils and personal health for the future can pay good dividends in the present as well.

Even a quick look at a sampling of present-day organic farms shows that they are making good use of much of the most advanced science and machinery available. They are large as well as medium and small farms. All these farmers are doing that is truly different is figuring out and using methods that let them avoid or reduce the use of chemical inputs brought in from outside the farm. Everything else about them is high-tech in its truest and most efficient form.

I trust this response fulfills your request. Please call me if you have further questions.

Sincerely,

MARIA VAN HEKKEN,
Director of Special Projects.

Senator LEAHY. Our next panel consists of Dr. Howes, Dr. Holt, Dr. Pesek, Dr. Lockeretz and Dr. Bezdicek. I have probably so totally fouled up the names that the panel is not sure who has been called here. [Laughter.]

Senator LEAHY. Gentlemen, why do you not come on up and start? Take seats in whatever order you would like. Let me just make sure I have got the names in the right order. Sir, you are?

Dr. HOWES. I am Cecil Howes, professor emeritus of Virginia Tech and Washington representative for the Council for Agricultural Science and Technology.

Senator LEAHY. From Blacksburg?

Dr. HOWES. From Blacksburg, sir.

Senator LEAHY. A pretty town.

Dr. HOWES. A lovely town, a beautiful place in which to live. Thank you for the comment. We appreciate every plug we can get.

Senator LEAHY. You are quite welcome.

Dr. PESEK. John Pesek, professor and head of the Agronomy Department at Iowa State University.

Senator LEAHY. A very good friend of mine in Burlington, VT, is from Ames, IA.

Dr. HOLT. I am Don Holt, director of the Illinois Agricultural Experiment Station.

Senator LEAHY. From Urbana.

Dr. BEZDICEK. I am David Bezdicek, professor of agronomy and soils at Washington State University.

Senator LEAHY. I really did a lousy job on your name, did I not? I apologize.

Dr. LOCKERETZ. I am William Lockeretz, research associate professor at the School of Nutrition, Tufts University, in Medford, MA.

Senator LEAHY. It has got to be cooler there than it is here.

Dr. LOCKERETZ. Barely.

Senator LEAHY. It is probably the same in Pullman, for that matter. Dr. Howes, let us start with you.

STATEMENT OF DR. CECIL HOWES, WASHINGTON REPRESENTATIVE, COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY, BLACKSBURG, VA

Dr. HOWES. Thank you, Mr. Chairman. We appreciate the opportunity to be here and to share our thinking with you.

CAST is the acronym for the Council for Agricultural Science and Technology and, of course, we are better known by that acronym. CAST is a consortium of 25 scientific societies, such having a total individual membership of approximately 60,000 agricultural scientists, and it encompasses most areas of agricultural production.[1]

It is designed as a service by the agricultural scientific community to provide an up-to-date summation of scientific data relating to items of national concern as such relate to food and agriculture, with accuracy, dispatch, and as free from personal biases or prejudices as is possible.

It is in that capacity that I am here, Mr. Chairman. I am not a specialist in these areas. However, the gentlemen who appear here with me are specialists and can answer any specific questions that may be raised.

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[1] See pp. 161–206 for additional material from Dr. Howes.

In a review of the stated purposes of S. 1128 and the information-gathering studies that are proposed to meet such purposes, it appears that much of the information being sought relates to the age-old discussions of the comparable efficacies of conventional and organic farming.

These two farming practices actually have much in common, differing principally in the use of modern chemical technology. Conventional farmers, of course, use commercial fertilizers, pesticides and animal feed additives to increase productivity.

But organic farmers prefer to do the same thing by the use of natural resources. Discussions of these two practices have generated considerable controversy and much emotion among Members of the general public, recurring coverage by the media, and attention by Members of Congress.

Several years ago—in fact, in 1978—CAST recognized the developing significance of these subjects, realizing that the scientific information required to place the issues in proper perspective was poorly known, was little appreciated and was generally overlooked by discussants.

Following a request from some Members of Congress, CAST directed the development of a report summarizing the scientific information available and needed to provide the necessary background for discussion.

The final task force that was appointed included 24 outstanding scientists selected by their scientific societies as being most knowledgeable in the subject area. The areas represented were agricultural economics, agricultural engineering, agronomy, animal science, dairy science, entomology, food science, horticulture, plant pathology, poultry science, rural sociology, soil science, soil testing and plant analysis, veterinary medicine, veterinary toxicology, and weed science.

The coverage of the agricultural picture was quite complete. The organic movement is, as we mentioned, controversial, and the scientific, economic and sociological bases for conventional farming and organic farming are not well known to many of the people who are concerned with the controversy and involved within it.

Therefore, the CAST report discusses several things: first, the evolution of the two farming systems; second, the commonality of the two systems; third, the implications of increased adoption of organic farming methods; and, last, small-scale organic gardening. Detailed investigations and evaluations are given in the report.

Because much information which is relative to the projects proposed by S. 1128, the Agricultural Productivity Act of 1983, is presently available and has been consolidated into the CAST task force report No. 84, organic and conventional farming compared, it might seem desirable that the report again be made available to members of the committee, and this has been done, Mr. Chairman.

Although the original report was published in October of 1980, it is apparent that the basic principles and the submitted scientific data remain pertinent at the present time.

In response to a request for CAST testimony at this hearing, and in the hope and the belief that the material contained will be useful, it is requested that task force report 84 be included in the records of this hearing, or as an appendum thereto, and also with a

packet containing a publication more recently made in the journal, Science of Food and Agriculture, also published for high school science students by CAST in March of 1984. I request that this be done.

Senator LEAHY. Let me review the material. Certainly, its availability here in the committee will be noted, and let me review the material as to efficacy of printing it as part of the record.

Dr. HOWES. CAST has also been requested to recommend some other persons from the scientific community especially well qualified to testify on the matters covered by S. 1128. Three such scientists were proposed, only two of whom have been able to be present.

It should be stated that each of the outstanding scientists have been asked to make independent statements based upon their individual knowledge and research, and are not representing a CAST position.

CAST, in accordance with its established procedures, makes no recommendations for action or for policy enactment, and has adopted no policy on this subject. We simply attempt to provide scientific background.

[The following letter was subsequently received by the subcommittee:]

COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY,
Ames, IA, July 16, 1984.

Hon. PATRICK LEAHY,
U.S. Senate, Committee on Appropriations,
Washington, DC.

DEAR SENATOR LEAHY: Reference is made to your letter dated June 20, 1984, accompanying copy of my comments at the Senate Agriculture Subcommittee on Research and General Legislation on June 24 on the Agricultural Productivity Act of 1983, S. 1128. I appreciate the opportunity to make that appearance, to introduce certain other scientists to you and to introduce the CAST Report No. 84, "Organic and Convention Farming Compared," into the testimony.

Specifically, in the cited letter you raised two questions for my response. The delay in reply (your letter was received July 9) was to permit a careful check of the background of development, and the accuracy of my comments. The questions you raised and my response to them follows.

(1) At your request, the 1980 CAST report on organic farming is being held by the Subcommittee as a reference document to the recent hearing on S. 1128. The report seems to focus on the effects of a widespread shift to organic farming to take place in the short run. What probability does CAST attach to the occurrence of such a widespread shift?

The seeming focus of CAST Report No. 84 on the effects of a widespread shift to organic farming in the short run is a consequence of the objective of the report, which was to compare the effects of the organic and conventional systems. Farm economics being what it is, the profit motive must be a primary guide to the practices used by most farmers who farm for a living. Farmers developed the system called conventional farming because it was more profitable than the largely organic system most of them had been using. Therefore, the probability of a widespread voluntary shift from conventional to organic farming is very small unless and until conventional farming becomes les profitable than organic farming. Then the change will take place spontaneously. The mechanics and adjustments involved in changing from one system to another rapidly or slowly on a given farm or in the n ation are another question.

(2) Table 6 in the report presents some rather sizeable yield differences between conventional and organic farms. Was this a comparison of conventional and organic farming data from the same time period or were data from the 1970s (conventional farms) compared with data from the 1940s ("organic" farms)?

Table 6 in CAST Report No. 84 presents estimated national average crop yields under conventional and organic farming. This table gives the end results of a computer simulation based upon a national linear program model of U.S. agriculture

projected to 1980. The authors of the study reported that the values given for organic farming were based upon farming practices used in 1944, with yields increased to 1980 levels to provide for the contributions of improved hybrids and varieties and of improved cultural practices other than those involving additional agricultural chemicals. Thus, the comparisons were effectively for the same time period.

We appreciate the opportunity to be of assistance in this important matter, and look forward to the possibility of being of further service as other matters of agricultural and food concern to the nation are developed.

Most respectfully yours,

C. E. HOWES, *Washington Representative.*

Dr. HOWES. In the interests of time, those presenting testimony at this hearing have been requested—the next two speakers have been requested to make brief oral presentations, with longer written statements which we hope will be recorded in the minutes of this meeting.

It is a very real pleasure to introduce to you the next two speakers, Dr. John Pesek, on my immediate right, and Dr. Den Holt, second to my right, who have been recommended by CAST as being outstanding scientists in this field of study, and they will be asked to identify themselves.

Senator LEAHY. Thank you. I also would note that Dr. Robert—I cannot read my own writing here.

Dr. KNIPPLING. Papendick?

Senator LEAHY. Papendick. Good Lord. My mother was right; she told me I should have been a doctor rather than a lawyer considering the way I write. But Dr. Papendick from the USDA was here earlier this morning.

Dr. KNIPPLING. Dr. Papendick is here.

Senator LEAHY. He is here and available to answer questions as we go along, and I will note that.

Why do we not start and go with Dr. Pesek first?

STATEMENT OF DR. JOHN PESEK, PROFESSOR AND HEAD, DEPARTMENT OF AGRONOMY, IOWA STATE UNIVERSITY, AMES, IA

Dr. PESEK. Thank you, Senator. I am John Pesek, professor and head of the Agronomy Department at Iowa State University.[1] I have been a research scientist and/or the administrator of the Agronomy Department for 34 years at Iowa State.

I am a product of a small organic farm, but then most people from a farm and of my vintage can say the same. I am, however, very strongly committed to efficient and adequate food production and agricultural resource conservation. I am convinced that agriculture is the most critical occupation of humankind.

Therefore, I welcome the effort of Congress to seek a better understanding of agricultural practices and options available in the United States, and support this thrust. But I find S. 1128 and its companion, H.R. 2714, to be somewhat inconsistent.

It appears that Congress wishes both to stimulate research and to demonstrate the transition of farms from what might be called conventional crop and animal production practices to systems which rely less or not at all on synthetically compounded production inputs of all types and on erosive cultivation practices.

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[1] See p. 207 for the prepared statement of Dr. Pesek.

The problem with S. 1128 is that it will not provide for good research, and may not provide for good demonstrations either. Research and demonstration are two very different activities and have different goals, so they must be pursued in different ways.

The bill essentially establishes an experimental design, and herein lies its greatest difficulty as far as I am concerned.

One, the number of comparisons is too few.

Two, there is no assurance that the farms selected are representative of the classes from which they are chosen.

Three, there are not enough treatment levels to characterize the range of possible transitions. It is not either yes or no; there are many points in between.

Four, the comparisons of whole farm operations are highly complex and difficult, especially when the net incomes of the operators are compared.

Five, finally, the length of the study, which is 5 years, is much too short. There are many reasons for that.

(a) There is no base for comparing before or after, or with or without.

(b) Many crop rotations simply cannot be completed within the time allocated.

(c) Measurement of changes in the crop production and soil properties, therefore, will be very difficult and might be very small.

(d) The climatic cycle in the Middle West where I work is four times as long as the horizon for the bill.

(e) Four- and five-year averages of crop production and income of farms is too short to make dependable projections.

To the lack of recovery from reported slumps in production in initial years of transition might bring us to the wrong conclusions.

Now, these can be corrected by providing for the experimental design to be prepared by identified scientists who have demonstrated ability in this field, and the bill amended to assure competence of the investigators who will do the research as well.

Senator LEAHY. But does that also include lengthening the time?

Dr. PESEK. As far as I am concerned, yes.

Senator LEAHY. By how many years?

Dr. PESEK. One suggestion I have is that the time limit for the research and/or demonstration should be a minimum of 10 years, and preferably 20. Actually, the research should never stop. This is what I have written.

Senator LEAHY. Well, is what we are saying that before we can give a model, it may be my grandchildren who are going to be working that model?

Dr. PESEK. Not necessarily.

Senator LEAHY. I do not know if I completely understand. If we are having such fast changes in agriculture now and in demographics and the economy of agriculture, do we really have the luxury of 20 years?

Dr. PESEK. This is true we do not have this luxury. In agriculture we utilize what information is available with whatever reservations we might have about this information. So, while we will start using early information which does work, the total answers I do not think can be reached within a 5-year period.

Senator LEAHY. Thank you.

Dr. PESEK. There are a couple of other observations I would like to make. There already have been some new and special thrusts along the lines proposed in the bill, and there is some continuing work which dates back several decades.

One of the things which Dr. Bentley did not have a chance to present specifically is the preliminary summary classifying the USDA and experiment station projects which we are doing in our department for the Cooperative State Research Service.

In the 18 States represented by members of this committee, there were 2,961 projects relevant to farming systems [fiscal year 1982]. Of these, almost 2,797 are neutral in terms of whether they apply to alternative systems or conventional systems. But 193 are very significantly oriented directly toward the organic systems.

The scientist years in these projects relevant to farming systems were 1,714. In those that are neutral, in terms of whether they are conventional or alternative systems, there are a few over 1,516. And in those that are specifically directed toward so-called organic farming there are 95. These are answers to some of the questions you raised earlier this morning.

I would also like to observe that agricultural practices must be intensive if we are to feed our population. They certainly have to be much more intensive than they were in the past.

Petroleum consumption in crop production and harvesting is a very small part of the national total, and agriculture is really no more vulnerable to the capriciousness of petroleum supply than is the rest of the economy.

As a citizen, I would point out that even if completely successful, the legislation in S. 1128 or H.R. 2714 will not really save the family farm. I think the family farm can be saved only by a change in agricultural and economic policies.

Senator LEAHY. But, you know, we do not have a policy that is simply going to be set down that we have now changed the economic policy re family farms. It becomes really an incremental thing, and may this not be one of those incremental parts? There are a whole lot of other things that go with it.

If we continue to accept these deficits that are being proposed, that is obviously going to hurt it because we are going to have interest rates skyrocketing next year, no matter who is President, and that is going to hurt it.

There are a lot of other things, but is this not one of those incremental things that might be considered?

Dr. PESEK. The point I am making is that many more things, far many more things other than the research program which is being proposed in these two bills, will have much greater influence than this legislation.

Senator LEAHY. I do not think anybody is suggesting otherwise.

Dr. PESEK. Where H.R. 2714 differs from S. 1128, I prefer the language of H.R. 2714 at the present time.

Thank you very much.

Senator LEAHY. Thank you. I have just been told that the Chairman is still delayed. They have just called up one of my amendments on the floor of the Senate, so I will have to go and continue that.

Rather than to have all these witnesses go and then come back, I am going to suggest that the staff hear the rest of the witnesses. I would not, if I were the witnesses, feel at all affronted by that because you must understand one thing that most political scientists have long ago realized that Senators are mere constitutional impediments to the staff totally running things anyway. [Laughter.]

Absent the constitutional requirement, there is really no necessity for the Senators at all. There is, however, a necessity for the staff, and so you will be in far better hands.

I do have a CAST document here which I would insert by unanimous consent into the record.[1] Thank you.

Mr. HILL. I am Dave Hill, a professional staff member for the majority.

Dr. Pesek, had you finished your testimony?

Dr. PESEK. Yes, sir.

Mr. HILL. Fine. Next, we will hear from Dr. Donald A. Holt, director of the Agricultural Experiment Station at the University of Illinois in Urbana, IL.

Dr. Holt.

STATEMENT OF DR. DONALD A. HOLT, DIRECTOR, AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF ILLINOIS, URBANA, IL.

Dr. HOLT. Thank you, Dave. I appreciate the recommendation by CAST and the invitation by Senator Lugar to voice an opinion on S. 1128.

I grew up on a rolling, badly eroded, unproductive farm in northern Illinois and farmed it myself for 7 years, during which time I implemented a soil conservation farm plan, served on the Kendall County, IL, soil conservation district.

I spent 20 years as a researcher in forage crop management, crop physiology, and computer simulation of crop growth before becoming head of the University of Illinois Agronomy Department. I am now director of the Illinois Agricultural Experiment Station.

One of my teaching and research specialities was design of field experiments. With this background, I have a personal and professional interest in productive and efficient farming systems and in the allocation of resources by the Federal Government to agricultural research development and educational activities.

I have provided the committee with a detailed written statement concerning S. 1128. It includes a critique of the experiment and demonstration described in the proposed legislation, some philosophy about farming systems research, and some alternative approaches to the problem of developing productive farming systems that are also profitable and that conserve soil and energy resources.

S. 1128 describes an experiment that would compare and demonstrate the differences between farming systems that (a) involve only crop production and that rely on chemical fertilizers, pesticides, growth regulators, feed additives, and intensive cultivation; and (b) farming systems that involve livestock production; crop ro-

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[1] See p. 161 for the material from CAST.

tations, including legumes, green manure, crop residues, animal manure, fertilizer with ground mineral-bearing rock, off-farm organic wastes, minimum tillage, biological pest control, and other practices often associated with soil conservation and lower energy inputs.

It is proposed to compare whole farms operated with each system and to measure the effects of transition from system A to system B. In my view, the proposed experiment and demonstration has several design flaws.

First, it apparently precludes the possibility of mixing the two packages of practices. An optimum combination of practices for a specific area, as dictated by economic, soil and weather conditions, might very well involve the use of some chemical fertilizer and pesticide, some energy-intensive practices, crop rotation, legumes, conservation tillage, et cetera.

To illustrate the importance of this concern, I want to point out that conservation tillage has only been successful in practical situations where chemical pesticides, including herbicides and insecticides, have been used. When used with appropriate safety and control measures, the combination of tillage technique and pesticides is one of the most cost-effective practices for conserving soil and energy.

The stated objective of the research prescribed in S. 1128 is to investigate many different variables, including chemical fertilizers, pesticides, rotations, tillage systems, green manure systems, manure applications, different crops, different livestock enterprises, irrigation systems, off-farm organic sources, and many others.

Within each of these categories, there are a large number of possible variations. The effect of adding just one two-level variable to a well-designed experiment is to double the size of the experiment.

With the proposed approach, researchers would end up with many of the factors confounded with each other and with the soil, climate and human resources associated with a specific farm.

In a confounded experiment, the researcher is unable to determine or to demonstrate the causes of observed differences in productivity and efficiency. Given the natural variability among soils, climates, and management levels associated with farms, it would take an enormous number of farms to generate the necessary data base.

The proposed approach is a tremendous oversimplification of the problem. There are much more reliable and cost-effective approaches and I will describe those in a minute.

No matter how much a farmer may favor soil and energy conservation, the farming system on his or her farm in almost all cases will ultimately be dictated by economic conditions. If the farmer is using an optimum combination of inputs, he cannot decrease one input without either substituting another or decreasing total production and net income.

The current problem facing farmers is that farming is extremely capital-intensive, land prices contributing greatly to this. This situation is exacerbated by the high interest rates which are devastating to many farmers.

It would definitely not be efficient or even feasible for most farmers to substitute land for energy. I do not see any strong inclination on their part to substitute labor for energy either.

From a national perspective, it is likely that the most efficient overall national energy use in agriculture will include energy-intensive farming systems on the level, productive soils and less energy-intensive systems on soils that are more subject to erosion.

It would definitely be wrong to conclude that the same system would be appropriate for every situation. There is another aspect of this bill that is inconsistent with the realities of the national ag situation.

This proposed work rests on the implicit assumption that U.S. cropping systems should shift toward forage crops. In general, forages must be marketed through red meat animals. To suggest a substantial increase in the production of red meat animals at a time when demand for red meat animal products is decreasing is to fly in the face of economic reality.

There are many alternative approaches to the problem of identifying productive and profitable farming systems that are also energy efficient and soil conserving. If one wishes to analyze the experiences of farmers with various systems, excellent data bases have already been generated by the detailed farm cost account systems used in various States.

A detailed objective study of the experience of farmers with conservation farm plans developed by the Soil Conservation Service is needed. There is a perception on the part of many people that the rate of acceptance of such plans is low and that a fairly large percentage of the plans are abandoned after a period of time.

If this is true, there are probably important underlying technological and economic reasons. A detailed study of the fate of these plans would certainly be appropriate.

Modern farming systems research involves systems analysis, simulation, and econometric modeling techniques that are not even mentioned in this proposal. There are already large-scale farm simulators available, and more are being developed with which most of the questions being raised in this legislation could be answered in a much quicker and more cost-effective way than with the proposed approach.

If you take this criticism a step further, I think we—and by we I mean researchers and farmers—already know the answers to the questions addressed by this proposed legislation.

What we really need are new technologies that are profitable and, at the same time, conserve energy and soil. Minimum tillage is an example of such a technology. It is catching on rapidly—not because it conserves soil, but because it conserves fuel and reduces costs. Considerable research is still needed to perfect this technique.

New developments in biotechnology are particularly promising. Chemical attractants will make a little bit of pesticide go a long way in controlling various pests. New gene transfer techniques will make it possible to transfer specific kinds of pests and stress resistance among species and lines of plants, thus greatly increasing the pool of such resistance and reducing the need for chemical pesti-

cides. Many other possibilities for biological control of pests are opening up.

The long-term possibilities for microbial fixation of nitrogen will almost certainly have important implications with regard to chemical fertilizer use, energy use, and many other things.

Development of foreign markets for rod meats and forages might increase the demand for forage crops, and thus increase the proportion of land devoted to their production. There is a tremendous need for increased research and development toward using agricultural products for energy and chemical feedstocks. Such efforts could greatly reduce our consumption of fossil energy forms and reduce our dependence on foreign oil and other resources. The surface has not even been scratched in exploring these possibilities as yet.

In summary, while the stated objectives of S. 1128 are laudable, the research and demonstration approach described is seriously flawed. The proposal would not provide new and useful information at either the farm or the policy level, and there are much more promising and desperately needed research and development efforts that could be supported by the resources required to implement S. 1128. The details of all of these concerns are presented in my written statement.

Thank you.

Mr. HILL. Thank you, Dr. Holt.

[The following letter was subsequently received by the subcommittee:]

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN,
OFFICE OF THE DIRECTOR, AGRICULTURAL EXPERIMENT STATION,
Urbana, IL, August 2, 1984.

Hon. JESSE HELMS,
Senate Committee on Agriculture, Nutrition and Forestry
Russell Senate Office Building, Washington, DC.

DEAR SENATOR HELMS: Thank you for the opportunity to respond to some questions relative to S-1128, sometimes referred to as the "Organic Farming" bill. Your questions are very appropriate and my opinions are as follows. In each case, I have restated the question and then responded.

Question 1. "You and other witnesses said the design and comparisons specified in S-1128 for "transition", whole farm research, would not result in reliable data for use by other farmers. If the bill were to specify whole farm comparisons utilizing minimum inputs of high energy-high cost chemicals, but omitted the procedural details of Section 5 and left such matters up to the research scientists to develop such design, do you believe appropriate research procedures could be developed and that useful and applicable results would result?"

Answer. I definitely feel the bill would be palatable to more scientists if the procedural details were left to their judgment. As I stated in my testimony, I don't believe the whole-farm approach described in the current version of the legislation would yield useful information. There are much better techniques already available.

I believe the general tone of the legislation would be much improved and more acceptable to scientists if the stated objective was to identify situations in which low input systems are appropriate and to develop new and innovative systems that are more widely applicable and economically realistic than current low input systems.

Question 2. "You said the length of time (5 years) specified in the bill is too short. What time-horizon would you use? And, with your indication of more years needed to obtain reliable results, how can researchers obtain information needed for education (Extension) use in a shorter time?"

Answer. The time-frame problem stems from the fact that economic, technical and social situations will always change and farming systems must accomodate to these changes. One of the great advantages of the simulation and econometric modeling approaches is that past, present, and predicted scenarios can be analyzed and optimal systems developed for many different situations. The models produced by

such efforts can be used to predict the impact of future changes in economic and social conditions and technology. Thus the research produces tools, namely the models, for use in the future. The modeling and simulation approach solves the time-frame problem, because it permits the researchers to draw on data and experience from past history and make reasonable predictions about possible future scenarios. It is predictable that systems research will have to continue far into the future. This is because new alternatives will be developed by typical agricultural research activities and these alternatives will have to be incorporated into workable systems. In my opinion, research grants for periods of three to five years, with periodic review to determine the progress being made, represent good research management and resource allocation.

Question 3. "The Department of Agriculture referred to crop rotation experiments at Lancaster, Wisconsin, as being appropriately designed and conducted to generate much useful information for "organic" or alternative farming system agricultural producers. Do you have comparable research in your state, and do you believe it could be used in analyses of whole farm comparisons, if such were justified?"

Answer. The farming systems research being conducted at the Lancaster, Wisconsin, experiment field is managed by a regional research team. The University of Illinois is a major participant in this research effort. In addition we have many experiments being conducted each year at ten field research centers in Illinois. These provide information necessary for developing and improving farming systems. The relevant experiments include long and short-term rotation studies, measurements of soil erosion as affected by cropping system, forage and grazing experiments, integrated pest management experiments, tillage systems research, intercropping experiments, and many others. Within two hundred feet of the door to my office is a cropping system experiment, including excellent comparisons of low and high input systems, that has been running for 107 years. This is the longest running experiment in the western hemisphere.

Question 4. "One witness said little is being done by researchers in USDA (and States, implied) on integrated production systems, such as IPM (Integrate Pest Management). Do you agree? What is the general magnitude of these efforts in your state?

Answer. The witness who stated that little is being done by rearchers either in USDA or by the state agricultural experiment stations on integrated production systems is mistaken. In fact, integrated pest management is one of the current research fads, and appropriately so, because it is very important. Our station alone is spending over $1,600,000 annually on integrated production systems research. This constitutes almost 6 per cent of our total research expenditure and about 6½ per cent of our scientific man-years. I suspect similar investments are being made at the other major agricultural experiment stations.

It's really a shame that the organic farming enthusiasts and some agricultural scientists have chosen to take an adversarial approach to this problem, rather than a cooperative one. Farming systems research is very popular currently, both on the national and international scene. The techniques for conducting this research are improving rapidly, aided much by recent developments in computers, simulation techniques, econometric modeling techniques, and artificial intelligence and expert systems. The answers to the questions raised by S-1128 can be provided. Some are already available.

There is a dimension to this problem that I haven't heard discussed by either side. The controversy between organic farming enthusiasts and those who take a more conventional approach usually hinges around the question as to whether or not low input systems are economically feasible. It is not generally recognized that three-quarters of the farmers in this nation are part-time farmers. For many of these, maximizing profits is not the major objective. They farm for other reasons, including the desire to be identified as farmers, to live and work with farmers, and to enjoy the aesthetic pleasures of farming and of living in the country. Because of the goals and motivations of these people, low input systems are likely to be most appropriate for them. Also, they tend to be situated in the least productive areas, often on hilly, highly erosive land. These people should be the primary target group of studies involving low input systems. The organic farmer groups should quit trying to convert those who farm the big, level productive farms. Low input systems will not be feasible on those farms until there are really drastic changes in energy costs.

Unfortunately, the debate about organic farming has degenerated into an idealogical struggle. If people on either side of this debate would simply sit down together and discuss technical details, specific situations, specific research approaches, and specific applications of technology, they would find there is not that much about which to disagree.

There are scientists and there are scientists. The good ones are interested in seeing that research is conducted properly, that conclusions are not drawn before the data has been analyzed, and that inferences are not extrapolated to situations where they don't apply. The purpose of sound research is to provide as accurate a perspective on reality as we can gain. To the extent that we understand reality, we are in a position to influence our destinies in a positive manner.

Thanks again for the opportunity to express my views.

Sincerely,

D. A. Holt, *Director.*

Mr. Hill. Next is Dr. David F. Bezdicek, I believe is how you pronounce it, professor of agronomy and soils for Washington State University at Pullman, WA. Welcome, Dr. Bezdicek. We will hear your testimony.

STATEMENT OF DR. DAVID F. BEZDICEK, PROFESSOR, AGRONOMY AND SOILS DEPARTMENT, WASHINGTON STATE UNIVERSITY, PULLMAN, WA

Dr. Bezdicek. I have prepared a statement about 8 to 10 minutes in length. I am prepared to shorten that to about 5 minutes, so in my statement I will be skimming over some of the material that is in my written testimony.

It is a pleasure for me to be here and offer my thoughts on S. 1128, the Agricultural Productivity Act of 1983. I am a soil microbiologist and professor of soils at Washington State University, where I teach several courses in soil microbiology, and more recently a course in world cropping systems.

My research efforts are in the area of biological nitrogen fixation by legumes, nitrogen-fixing micro-organisms, cropping systems, and nutrient cycling.

I am especially concerned about the future of American agriculture in view of the relatively large number of farm foreclosures and the loss of family farms. This act is indirectly asking us to take a look at the direction of our agriculture and some of the systematic problems we face.

Farmers are looking very hard for alternatives to their present situation, but are not offerod many choices outside the methods now accepted. In taking a systems approach, this act hopes to develop and substantiate some real alternatives and let farmers make the choices themselves.

Most farmers will not make changes that involve much risk, due to both their nature and their pocketbook. The changes we have witnessed in agriculture in the recent past were relatively low-risk, being based on extensive research and testing.

Alternative methods of production must also be given the same thoroughness of investigation if we hope to provide real choices.

In late 1981 we held a special symposium on organic farming at the American Society of Agronomy convention in Atlanta, GA. ASA is a professional society of over 12,000 members, comprised of agronomists, crop scientists, and soil scientists.

As chairman of the sponsoring division, I can say that the symposium was highly successful and one of the best attended in the society's history. Symposium proceedings are now published by ASA and contain 15 chapter contributions.

This act proposes to identify, assess and classify information on legume-based rotations, green manures, organic residues and

wastes, and intercropping practices. Although long-term rotation studies were common in the 1930's to 1950's, much of this information is out of date because soil nutrient levels have changed, plant varieties are improved, and tillage and other agricultural practices are different.

Our more recent production research results are taken from systems dependent on high chemical inputs. Today, very few long-term rotation studies are underway that address a holistic approach on the effects of crop rotations on yield, soil productivity, soil erosion, and the control of disease, weed, and insect pests.

In today's publish-or-perish system, there is little incentive for a young university or USDA scientist to undertake a long-term study that will not rapidly yield publishable results.

The current trend for the USDA-ARS and universities toward more fundamental research further emphasizes the need for more holistic, onfarm types of research.

The pilot research and demonstration projects of this act are essential and take a holistic view of integrating information from a number of disciplines, and should not be viewed as a scenario of what would happen if the entire United States were to farm organically.

One common phenomenon observed by many farmers in changing from conventional to organic methods is the lower yields that occur during the first 2 or 3 years of transition, after which time yields in the organic systems increase.

Few scientific studies have been conducted on either the transition process or on a comparison of organic and conventional farms. One such study was initiated in 1981 at the Rodale Research Center.

In a study at Washington State University recently on two adjacent farms, the effect of different management practices was studied. One farm, termed "organic" for the purpose of this report, was comprised of 800 acres where inorganic fertilizers were never used and herbicides were used minimally.

On the adjacent conventional farm, the usual recommended quantities of fertilizer and herbicides were applied. The level of several soil enzymes and the quantity of micro-organisms were significantly higher on the organic farm. Soil test levels for phosphorous and potassium were also higher for the organic farm, although phosphorous was never applied to the organic farm and potassium was never applied to either farm. The yields on both farms were about equal.

In the above study, there is no apparent explanation as to why or how production on the organic farm was maintained without inputs of fertilizer, nitrogen, and phosphorous. Based on our present knowledge, a severe yield reduction would occur initially if the conventional farmer adopted the practices of his neighbor.

This act provides for a unique and valuable opportunity to carry out the goals and needs that are not being met adequately in current programs. The pilot research and demonstration projects focus on a holistic approach where the scientific expertise of many disciplines can be used to package the best available technology into farm scale practices that will serve as a model to interested farm-

ers. Most importantly, it reduces the risk for decisions that farmers must make on alternatives.

That concludes my testimony.

[The following letter from Dr. Bezdicek was subsequently received by the subcommittee:]

WASHINGTON STATE UNIVERSITY,
DEPARTMENT OF AGRONOMY AND SOILS,
Pullman, WA, July 17, 1984.

Hon. PATRICK J. LEAHY,
Senator, U.S. Senate,
Russell Senate Office Building, Washington, DC.

DEAR SENATOR LEAHY: I'm enclosing the original copy of my testimony on the Agricultural Productivity Act of 1983, S. 1128. In reference to your letter of 20 June, 1984, I'm responding to the two questions.

Question 1. In statements at the hearing on S. 1128, some witnesses indicated that the research called for in this bill was unnecessary because the information was already available. From your experience would you agree?

Answer. No. Some of the research called for in this bill is being done, but only in a piecemeal fashion, and often along very narrow and disciplinary lines. There are few efforts to integrate this needed research into a package that can be used by the farmer.

Question 2. You stated that there is a need for taking a holistic approach to organic farming research. Would you elaborate on the reasons for desiring holistic research and the weaknesses in piecemeal research for filling the gaps in our knowledge about organic farming?

Answer. As I indicated in my testimony, the current trend towards more basic research and the increased pressure on university and USDA scientists to publish has discouraged the more applied research efforts and research involving either an interdisciplinary or long-term committment. Therefore, there is little incentive from a professional viewpoint for a young scientist to get involved in any long term study where research is integrated from a number of disciplines.

In our research on biological nitrogen fixation in legumes which is typical of studies at many other universities, we still use herbicides and insecticides. From these studies, we are able to provide answers only on the value of legumes in rotation for supplying nitrogen, but not on what substitutes are available for herbicides and insecticides in the rotation. All these answers are needed to "package" this information to farmers. Such a package of information is not currently available to farmers and will only come through more holistic, on-farm, research as described in S. 1128. My concluding comments are that the period of study for the transition phase is probably too short and that some further consideration be given to the experimental design and to the statistical evaluation of data to be collected.

Best regards,

D. F. BEZDICEK, *Professor of Soils.*

Mr. HILL. Thank you, Doctor.

The final witness for this panel is Dr. William Lockeretz, research associate professor for the School of Nutrition at Tufts University in Medford, MA.

Dr. LOCKERETZ. Thank you. Before I read my prepared remarks, I would like to add something concerning the CAST report that has been featured prominently at this panel. Around the time the report came out, I wrote a review and critique of it which was published in the New Land Review, a publication from the Center for Rural Affairs in Walthill, NE.

In view of the prominence given to the CAST report at this panel, I would like to request that that review be included with the documents of this hearing. The name of the review is "Different Script, Same Old CAST."[1]

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[1] See p. 212 for the prepared statement of Dr. Lockeretz, and p. 214 for a reprint of the review furnished by Dr. Lockeretz.

Mr. HILL. It will be included.

STATEMENT OF DR. WILLIAM LOCKERETZ, SCHOOL OF NUTRITION, TUFTS UNIVERSITY, MEDFORD, MA

Dr. LOCKERETZ. I would like to make just one main point today, which is that agricultural researchers have shown that they are highly interested in the alternative systems covered by this act, but that the resources to do much about just have not been there.

Like Dr. Youngberg, who testified earlier, I too have just come back from a major agricultural conference at Michigan State University entitled "Sustainable Agriculture and Integrated Farming Systems."

That conference was about the same concepts that are included in the introduction of the Agricultural Productivity Act of 1983. There were speakers from every region of the Unitod States, and also several countries of Western Europe. Their papers dealt with farming systems that avoid environmentally damaging pesticides, that conserve energy and other limited resources, and that reduce soil erosion and runoff.

This conference shows how quickly interest in this subject has grown among all sorts of agricultural researchers. Ten years ago my colleagues and I at Washington University in St. Louis began studying commercial organic farms in the Corn Belt. At the time, we were the only people doing anything like that.

But at the Michigan State conference, not only was my talk just one out of many, but, in fact, my paper alone reviewed close to a dozen other research efforts, including the one that Dr. Bezdicek referred to.

These efforts have been done at many different parts of the country and have looked at the subject of organic farming from many different viewpoints—economics, soil science, sociology, ecology, and so forth. Clearly, the subject has come a long way in just a decade.

I would like to mention a few other events that further prove how rapidly interest in this subject has grown. You are undoubtedly quite familiar with the 1980 USDA report on organic farming, which became one of the best known and most frequently requested reports in USDA history.

The 1981 symposium of the American Society of Agronomy has already been mentioned by Dr. Bezdicek. That symposium had 15 prominent American and European speakers. In 1982 a conference was held at the Massachusetts Institute of Technology under the sponsorship of the International Federation of Organic Agriculture Movements. Some 45 papers were presented, including many from the USDA and the land-grant colleges. The theme was resource-conserving, environmentally sound agricultural alternatives; in other words, the same basic ideas as are in the Agricultural Productivity Act.

But if there is so much interest in this subject already, a logical question might be why do we need a bill directing that there be more research in it? The answer is that so far only the scantiest resources have been made available to do anything about this interest in organic farming.

Certainly, there has been a lot of work that is relevant to organic farming, but "relevant to" is quite different from being about organic farming. And I would caution you to be very wary of work that might very well have been done anyway, and that then gets redefined as organic farming research, if it is convenient to so redefine it.

The studies that actually were about organic farming that I talked about in my Michigan State paper were undertaken with minimal time, money and personnel—typically, graduate student projects conductod on just one or two farms, maybe running 1 or 2 years.

As we have heard again and again today, this is hardly enough to do justice to a subject that is as complicated as integrated farming systems. After all, the key element in an integrated farming system is linking up all the separate pieces of farm management—pest control, fertilization, tillage, crop rotation, livestock feeding, and so forth.

Secretary Bentley earlier mentioned many USDA research projects on these individual topics, but if there is a single principle that could describe what we mean by integrated farming systems—and I want to emphasize systems—it is that the whole is not simply the same as the sum of the parts. In other words, there is no substitute for whole-farm research, as proposed in this act.

The Agricultural Productivity Act, in my opinion, will go far to advance our understanding of integratod, resource-conserving alternative farming systems. It provides for work in different regions of the country and on many different kinds of farms. It also allows the research to run continuously for 5 years at a stretch, which may not be enough, but it certainly beats the year or two available to most of the efforts that have been done recently.

In conclusion, the agricultural research community clearly has shown that it believes that we should give more attention to the kinds of agricultural systems that the Agricultural Productivity Act deals with. But researchers simply have not been given the means to mount an adequate program. The act will help to correct this imbalance.

American farmers will need to be able to respond to ever-greater resource, environmental and economic pressures over the next several decades. The modest level of funds that the act authorizes for this purpose, in my opinion, will be repaid many times over by giving farmers more ways to meet these challenges.

Thank you.

[Responses to written questions from Senator Patrick Leahy by Dr. William Lockeretz:]

Question 1. Since studies of organic agriculture began in the mid-1970s, changes have occurred in energy costs, land prices and other input costs. Do you see these and similar changes as favoring the widened adoption of organic farming methods or being a detriment to it?

Answer. The first studies of organic farming, which concentrated on grain/livestock farms, began in 1974. Looking back, we now know that economic conditions in that year were exceptionally favorable for conventional production and would work against an organic system in a direct economic comparison. Nevertheless, as I indicated in my testimony, the organic farms we began studying in 1974 turned out to be doing quite well economically. Were we to do an updated study of the same farms in 1984, without question the results would be even more favorable for organic farming.

The main difference between organic and conventional production on the output side is that organic farmers produce more hay and less corn. On the input side, of course, the main difference is that they do not use conventional purchased fertilizers and pesticides.

In May, 1984, the price of corn stood at $3.36 per bushel, up 14% from the 1974 season average of $2.95. Hay, on the other hand, was selling for $84.90 per ton, up 68% from the 1974 price of $50.60. Clearly, then, price changes of the past decade have been advantageous for the output mix typical of organic farms. Moreover, a change toward more hay and less corn would be desirable from two public policy standpoints, soil conservation and price supports. Hay suffers far less erosion than corn, and there is a program to roduce corn surpluses but none for hay. Thus organic farmers on their own are already contributing toward two national goals for which the government is paying conventional farmers. Nor have these rather costly payments been overwhelmingly effective, either.

As for purchased inputs, in the past decade the prices of fertilizers and of agricultural chemicals (e.g., insecticides, herbicides) have risen by 60% and 70% respectively. This can be compared to an increase of only 14% in the price of corn, the leading recipient of these materials. (For all crops together, the price increase since 1974 has been 23%.) These changes favor a reduction in the use of fertilizers and pesticides, even at the cost of some loss of yield. (In actual fact, the organic farmers we studied had only slightly reduced yields despite complete elimination of these materials.) Once again, besides being a sensible way for an individual farmer to respond to changing prices, a reduction in fertilizer and chemical use would also further the national goal of energy conservation.

Question 2. As we look forward into the future we have to be concerned with the adequacy of world food production. In your view, does organic agriculture have a role to play in helping to feed the world?

Answer. Here, too, it is informative to compare the current situation to that of 1974. That was the year of "All out food production for the world food crisis." At the time, a frequently heard criticism of organic farming was that we couldn't feed the world if we switched to organic farming, since grain output would drop.

Since then, the world food picture has changed sharply. There is a strong belief that the only satisfactory long-term solution to inadequate food supplies in the chronically food-short parts of the world is for those countries to raise much more of their own food, rather than depending on exporting nations like the U.S.

The earlier approach to achieving this, popularly known as the "Green Revolution," was strongly linked to greater use of fertilizers and pesticides in the developing world. In the past decade the price of these materials has risen so sharply that in effect they are unavailable to many farmers. Moreover, importing such materials places a heavy drain on hard currency reserves, a resource in very scarce supply in countries plagued by severe indebtedness and high bills for imported oil. Thus it is generally believed that the developing world must make much better use of noncommercial, indigenous organic materials for fertilization, and non-chemical methods for pest control, if they are to raise enough food at an affordable cost.

Moreover, such a change could have important economic benefits for the U.S. as well. In 1974, unprecedented demand for U.S. grain was thought to signal the end of the problem of chronic surpluses, and indeed, for three more years the government did not pay farmers to reduce grain output.

But it no longer is a seller's market, in which a grain-hungry world is clamoring to buy whatever it can get from the fortunate nations that have exportable supplies, especially the U.S. The euphoria of the mid 1970s faded quickly when we learned how rapidly burdensome surpluses accumulate with true "all-out production." Moreover, high priced land and machinery bought on borrowed capital during one or two years of unusually high crop prices become a heavy load for the nation's grain farmers when prices subside to more typical levels. There is a growing realization that relying on ever increasing export markets at best offers a very risky and uncertain way to improve farmers' long-range economic outlook. It would be much more prudent to produce only for domestic needs plus a reasonable and reliable level of exports. Organic farming, which emphasizes a diversified crop output and less specialization on cash grains, would help achieve this and thereby contribute to greater stability.

Mr. HILL. Thank you, Dr. Lockeretz.

Before we let you go, as a forewarning, there were questions that were prepared and, I know, wanted to be asked of the panelists. But since no members are here, they will be submitted in writing

for written response. Cooperation on those efforts will be greatly appreciatod, and we do thank you all for coming here today.

The last panel of the day will be our public panel, and we will hear from Erik Jansson, Justin Ward, Terry Gips, Clinton Miller, and Dr. Charles Benbrook, so if they could come forward, please?

We do thank you for coming here today and, again, on behalf of the subcommittee, I would like to apologize for my having to sit in this chair, but since you are in town, we are very interested in hearing your testimony. As we did with the previous panel, we will start at my right and work down, if there is no objection to that.

Dr. Benbrook was not able to attend today, so in his place we will be hearing from Dr. Elinor Cruze, who is the scientific adviser, Board on Agriculture, National Academy of Sciences.

Dr. Cruze?

STATEMENT OF DR. ELINOR CRUZE, SCIENTIFIC ADVISOR, BOARD ON AGRICULTURE, NATIONAL ACADEMY OF SCIENCES

Dr. CRUZE. Mr. Chairman, members of the subcommitte, I am Dr. Elinor Cruze, scientific advisor for the Board on Agriculture, National Research Council. The Board on Agriculture is one of eight major operating units in the NRC. We focus our efforts on the agricultural sciences and the many ways science and technology impact U.S. agriculture.

We also carry out studies on renewable resource issues and environmental and regulatory concerns. Fisheries, wildlife, and forestry resources also fall within the purview of the Board.

The specific projects undertaken by the Board may address a full spectrum of issues, from basic science and research questions to education and manpower needs and Federal policies.

Dr. Benbrook recently presented an address for Frank Press at the National Governors Conference, and a copy of this is attached for your review.

The Board on Agriculture has no formal position on the legislation. The Board is, however, keenly interested in how alternative farming methods can help increase productivity on American farms. The Board would very much like to study and possibly explain how alternative management systems use natural processes in place of purchased inputs. This is a valid and intriguing scientific question.

I am going to skip over areas that have been covered concerning the advantages that are perceived to pertain to organic farming.

The 1980 USDA report on organic farming indicated that even a partial shift to low-energy agricultural systems would alleviate some major problems confronting U.S. farmers. Some of these benefits are lower operating costs, more effective erosion control, increased environmental protection, and a more self-sufficient and sustainable production system.

A degree of public confusion and ideological disagreement continues, however, regarding whether organic farming is a labor and manure-intensive regression into the past, or an economically viable, modern production system.

This wide range of perceptions suggests that an impartial assessment needs to be made of the scientific basis of organic farming as

part of modern production agriculture. If enacted and carried out, S. 1128 would provide data useful to such an assessment.

Organic farming and alternative management systems are receiving broader recognition as important areas for research. Public interest is also growing. The Board on Agriculture believes the time has come to examine these systems, with a view to overall farm policies.

We see increasing evidence that these systems have the potential to reduce farmers' costs of production. It is also possible that they can be used as a cost-effective supply control strategy in the context of our commodity programs, while also encouraging sounder resource use patterns.

The Board on Agriculture discussed these issues during its May meeting, and decided to approve a proposal for a project which would explore the policy implications of and research needs for alternative farming systems.

Pending approval by the NRC governing board, the Board on Agriculture will pursue funding to undertake an NAS–NRC study entitled "The Role of Alternative Farming Methods in Modern Production Agriculture."

The objectives for the proposed Board on Agriculture study are, (1) summarize scientific knowledge relevant to potential future uses and benefits of alternative farming systems in U.S. agriculture, updating and building from the USDA 1980 report; (2) examine the potential of these systems as a means to accomplish national soil conservation and production adjustment goals; (3) define and prioritize a research agenda. We have attached a copy of the proposal for your review.

I would now like to turn to specific issues related to the bill. We are concerned about the process used to select the six farms for the pilot research projects. It is important that such research and demonstration projects be conducted on real, functioning farms.

The information from the projects will be most valuable if it comes from production systems used by organic or alternative farmers able to compete with their neighbors using conventional techniques.

The research design should focus, to the extent possible, on documenting the physical and chemical processes and cycles which allow certain farmers to produce profitably with relatively fewer purchased inputs.

Another related concern is the need to investigate organic farming as an integrated system and not just simply look at the components separately. This point was made earlier today.

Cole and Lockeretz, in a statement prepared for the House subcommittee hearings on the Organic Farming Act of 1982, noted that the worst possible outcome of establishing regional centers would be for them to fall into the hands of researchers who do not understand what organic farming is.

A lack of understanding or a bias against organic principles would lead to experimentation purporting to compare conventional with organic farming systems. The scientific validity of such an experiment would be questioned if the only real difference between the plots were simply, for example, herbicide-treated versus untreated.

Organic agriculture is not the mere absence of conventional production practices. Organic farming is a systematic production system that uses a combination of practices, including crop rotation, legumes as a source of nitrogen, and appropriate tillage and cultural practices, and so forth.

Such systems take time to implement and must be carefully monitorod, and require good management skills, just like conventional systems.

This legislation is responsive, maybe not in an optimal way, to a legitimate set of concerns felt by many farmers, ranchers, consumers, and rural residents. I think it is clear that a majority of the some 2.5 million U.S. farmers would both welcome and benefit from a sustained commitment to such a research program.

The million-plus small-scale market gardeners also have major unmet information needs which this bill would help address.

I think a disservice is done to U.S. agriculture as a whole by not responding in a more balanced way to the research and education needs of this particular agricultural constituency.

Research on alternative, low-cost production systems may also lead to important new insights that benefit all farmers.

Thank you for the opportunity to present these views.

Mr. HILL. Thank you, Dr. Cruze.

Next on the panel is Erik Jansson, who is research associate for pesticides for Friends of the Earth here in Washington, DC.[1]

Mr. Jansson.

STATEMENT OF ERIK JANSSON, RESEARCH ASSOCIATE FOR PESTICIDES, FRIENDS OF THE EARTH

Mr. JANSSON. Well, we heard earlier from Orville Bentley about the smattering of research that USDA does on this subject. There is no coordination. The whole concept of organic farming went right by them, as it does at USDA in general.

They are talking about this and that; they are not talking about a systems approach to cost control, and that is what organic farming basically is. It is a cost control system, looking at the entire farm as an integrated whole. You can see that, for example, in animal production.

For example, in the United States, 50 percent of total sales from farming is animals. USDA has not come up with a program yet to integrate the animal and the crop system on the farm as a whole. There are a lot of things to be done in that area to save money.

Of course, the traditional type of organic farming is to integrate the two—to use the manure, compost it, and put it on your crops. There is a lot to be done in that area to save money.

I think this is a great bill, but I think that we are going to have to take the second step. We must get USDA involved in cost control. American farmers are going bankrupt; they are really squeezed. My parents are farmers, and it is not easy to be a farmer today.

We must provide people with information on how to reduce costs of their production, and I will give you an example from our situa-

[1] See p. 216 for the prepared statement of Mr. Jansson.

tion. We are a southern Maryland farm and we grow tobacco and normal types of crops. We are growing organic tobacco.

We went to the extension agent and said, is there any way we can grow a tobacco without pesticides? He said, no way; that is impossible. So we went to our forestry expert; we have a specialist who works on the farm in forestry and he recommended a program for biological control for tobacco, which works fine. We have not sprayed in 5 years and the tobacco is not eaten up by the insects. It works great.

We are intercropping winter wheat with legumes. We put the clover in and in the springtime when you harvest your wheat, up comes clover. The extension agent said that was impossible. The only reason we are doing that is we have Mennonites doing the work.

The whole thing is crazy, and I think it is really time that we have to think about reorganizing the Department of Agriculture to look at cost control. I think the test of that will be that some time in the future when we come down and look at USDA's structure, they will have an Office of Farm Cost Control right in their structure so that the whole thing is integrated, down to the extension agent. And a farmer can go to his extension agent and get some decent advice on how to make more money.

I think if we are not careful, we are going to have a serious situation in this country. Here we are; we have 25 percent now who are hooked into the export market. It looks like, with the high dollar, we are losing a competitive advantage.

There is only one thing to do there. You have to give farmers an opportunity to roduce the production costs so they can compete in the foreign markets. If we do not do that, then you get this full train of events where land prices fall, the bankers call in the credit, and so forth.

I think we owe it to our farming community to get USDA involved in cost control, and I am just amazed at the opposition of this agency to doing these types of things like integrated pest management and organic farming. They are cost control systems for the farm and USDA is opposed to them. I think we have to insist that USDA becomes interested in cost controls to help our farmers.

This is a wonderful start and I am glad to see this bill moving ahead. Thank you.

Mr. HILL. Thank you.

[The following letter was subsequently received by the subcommittee:]

FRIENDS OF THE EARTH,
Washington, DC, June 20, 1984.

DEAR MEMBERS OF THE SENATE: The Senate Subcommittee on Agricultural Research and General Legislation held hearings last Thursday, June 14, on the Agricultural Productivity Act (S. 1128). There are now 24 Senate co-sponsors of the legislation, including Senator Leahy who introduced it.

The testimony was of great interest. For example, Mr. Bruce Hawley of the American Farm Bureau took a strong stand in favor of "cost reduction on the farm", a position that agrees with that of the National Grange and National Farmers Union. The two later groups support the Agricultural Productivity Act, which provides for research of cost reducing organic farm methods on 12 working farms—whole farm research.

Mr. Hawley indicated that he thought that the Agricultural Productivity Act was "an overly timid step in the right direction" and proposed a much more aggressive

and expensive program aimed at cost reduction on the farm which he believes is seriously needed. For example, he noted the following: "As this committee is aware, agricultural chemicals, including fertilizers and pesticides, now rank fourth as an expense item in agriculture behind feed purchase, equipment repair and operation, and capital consumption items. Agricultural chemicals are the most rapidly increasing expense on the input side of production agriculture. A considerable share of this increase is tied to the cost of petroleum; however, the research to develop and clear new products is pushing pesticides more and more into the high cost bracket. Farmers spend between $9 and $10 billion annually for fertilizer and lime and about $3.5 billion for pesticides. Alternative technologies that would reduce the necessity of depending on these chemicals, or replace the need for them entirely in some instances, would obviously be of great benefit to the agricultural producer, the consumer, and the environment."

Why European small nations spend more on organic research than USA

Mr. Terry Gips of the International Alliance for Sustainable Agriculture presented evidence that European nations and Canada are far outspending the United States in organic farm research to reduce farm costs, and believe that they can compete better internationally with this research, and undercut the prices of American farmers already under pressure from a high dollar.

In 1982, the Ministry of Agriculture of Quebec began a 12 farm and 5 year research program on organic farming which closely resembles the one proposed in the Agricultural Productivity Act.

Table 1 lays out a comparison of research expenditures for narrowly defined "organic" farm research in Europe with that of the pending Agricultural Productivity Act in the Senate.

TABLE 1.—*Organic farm research expenditures in Europe, compared to the proposed Agricultural Productivity Act*

Country:	*Per year*
Germany (million)	$1.5
Switzerland (thousand)	$650
Norway, Sweden, Finland (million)	$1.0
Netherlands (million)	$3.0
Proposed for United States—Agricultural Productivity Act (million)	$2.1

Why the Netherlands spends so much

Dr. Pieter Vereijken, of the Dutch government, explained why the Netherlands with a population of 15 million people, which is the size of New York State, should be making such a financial commitment to organic farm research: "We were the first to feel the problems because we have a very advanced agricultural system. We want to continue to live with our land and have the world's highest yields. For this reason, we have made a major commitment to research in biological agriculture."

I am also enclosing our testimony on the need for both research on organic or biological farming, and secondly for an Office of Cost Control at USDA. Note in particular Chart 1 on page 2 of the testimony.

We hope that you can co-sponsor the Agricultural Productivity Act, so that it can move through the Senate this year.

With best regards,

ERIK JANSSON.

Mr. HILL. Next on the panel is Justin Ward, who is agricultural project assistant for the Natural Resources Defense Council here in Washington.

Mr. Ward.

STATEMENT OF JUSTIN R. WARD, AGRICULTURAL PROJECT ASSISTANT, NATURAL RESOURCES DEFENSE COUNCIL

Mr. WARD. Thank you very much, Dave. We appreciate the opportunity to appear teday before the subcommittee. The Natural Resources Defense Council, or NRDC, is a nonprofit corporation with more than 40,000 members and contributors who are dedicated to the preservation, enhancement and defense of the natural resources of the United States and the world.

I will summarize our testimony today and ask that our full, complete statement be included in the record of these hearings.[1]

NRDC is pleased to register its strong support for S. 1128, which is the Senate companion to the House-passed Agricultural Productivity Act of 1983. We wish at the outset to commend those members of the subcommittee who have cosponsored this beneficial legislation.

In essence, this bill can be regarded as a research and assistance measure which calls for the badly needed development of more complete information on promising farm techniques in the face of a range of challenges to the viability and sustainability of modern agriculture.

Our statement will briefly address the advantages of the bill and answer the few objections that have been raised against it.

As to advantages, the proposal is based on the welcome recognition that desirable farmer and social objectives need not be mutually exclusive. For instance, the stated purpose of the act in section 3(1) is to simultaneously promote increased productivity, environmental conservation, and cost effectiveness.

In addition, the proposed research program in S. 1128 is wisely designed to encourage the development and integration of environmentally superior farming practices into the existing framework of modern agricultural technology. We believe this is a preferable and practical option to offering them as comprehensive substitutes for systems already in place.

Through pilot research, the act calls for nothing more than an examination of the effects of a measured transition from chemical-intensive farm practices to regenerative farming based upon naturally productive techniques such as crop rotation and the use of manure. The proposed legislation in no way advocates an across-the-board replacement of existing systems.

As has been mentioned earlier today, the benefits of such techniques are well identified in USDA's 1980 Report and Recommendations on Organic Farming. That informative study addressed various issues of concern to NRDC, including topsoil loss, declining soil productivity, and environmental degradation, with accompanying human health risks from pesticide use.

The major operative provisions of this bill are sound, and they have been discussed at some length throughout today's hearing. They need little elaboration here—the information study in section 4, the pilot research projects in section 5, and the intercropping assistance provision in section 10.

In short, we believe S. 1128 is a well-conceived, reasonable measure which should not in any sense be controversial. Nevertheless, there has been some opposition to this legislation. In particular, three basic objections that have surfaced during the process deserve rebuttal.

First, the claim that the research program embodied in S. 1128 is duplicative of existing work is simply untrue. No federally sponsored research currently involves the sort of case study approach as called for in the bill needed to rigorously examine entire farming systems.

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[1] See p. 225 for the prepared statement of Mr. Ward.

Second, the contention that the bill's provisions unreasonably constrain research design is unfounded. The bill allows abundant flexibility in this regard, especially in section 6 dealing with coordination, which provides that an appointed interagency advisory council shall participate in the design of the 5-year pilot onfarm studies.

Moreover, although the sample size for the pilot research is small and the requisite time period for the study short, there is little doubt that, provided the experiments are conducted scientifically, in consultation with a variety of experts, valid and useful statistical results can be obtained.

Finally, contrary to suggestions made by opponents of S. 1128, this legislation is not inordinately expensive. In fact, we believe it constitutes a rather modest approach to a complex and challenging problem. Indeed, the proposed funding allocation of $10.5 million over 5 years represents only a tiny fraction of the overall USDA research budget and would not drain money devoted to the other vital USDA research needs.

Certainly, we are sensitive to the need for fiscal restraint in the face of today's large Federal budget deficits. I can assure you, however, that we would not be here today if we were not convinced that the benefits of this research investment will ultimately outweigh the cost to the Treasury over the long run.

As Senator Leahy stated in his introductory remarks on the floor, the cost of this effort would be minimal and the benefits to American agriculture, the consumer, and the environment would be substantial.

In sum, NRDC believes the act would simply assist USDA in fulfilling its basic responsibilities to provide support to American farmers. It is clearly a necessary and proper function of the Department of Agriculture to serve as a catalyst for the development of and a clearinghouse for information about cost-effective, conservation-oriented agricultural techniques. This bill is a sensitive and constructive response to the problems facing American farmers today.

Thank you very much.

Mr. Hill. Thank you, Justin.

Next we Mr. Clinton R. Miller, the legislative advocate for the National Health Foundation from Virginia. Mr. Miller, welcome.

STATEMENT OF CLINTON R. MILLER, LEGISLATIVE ADVOCATE, NATIONAL HEALTH FEDERATION

Mr. Miller. Thank you very much. Mr. Chairman, I am pleased to appear before you in strong support of S. 1128/H.R. 2714.[1] It is a superb bill. It is drafted with consummate skill. I agree with Senator Leahy when he said that the staffs do the work. I am aware of what Weaver's staff did in the House and what your staff has done here, and I do not agree with those that say that this would be a small, minuscule step forward.

My personal feeling is that when this legislation is enacted, and I am certain it will be enacted, that it will be looked at by future

[1] See p. 227 for the prepared statement of Mr. Miller.

generations as a major step forward in the history of this country. And I believe your Senator will be given awards for generations for his role in it.

Now, my name is Clinton Ray Miller. I have represented the National Health Federation for the past 23 years as its health freedom legislative advocate. We believe that responsible, informed health freedom is as important as religious and political freedom, and that three freedoms are interdependent; we cannot have one without the others.

The National Health Federation publishes a monthly journal called the Health Freedom News, and holds educative seminars and conventions for our 17,000 members and their friends in major cities throughout the United States.

Because we support and defend health freedom, we open our conventions and journal to new and sometimes unorthodox opinions and theories by scientists and lay people concerning the least expensive, the safest, and the best ways to obtain and regain health.

As such, we are sometimes open to criticism of being, instead of NHF, NAGG, which would be the National Association for Granola, Grandmothers, and Grandfathers. We are not ashamed of the fact that we defend the right of people to express unpopular points of view.

Now, we are concerned about soil fertility, and not production, as this bill is directed to, but human health. We believe that once the bill passes, quickly people will be aware of that which has been so obvious to those that have been doing organic gardening in the past, that the link is direct.

Now, over the past 28 years we have had several individuals speak at our NHF conventions defending their sincerely beliefs and theories that the nutritional value of plants is directly related to the fertility of the soil on which they are grown.

Now, what is more important is they have argued convincingly that the health, vitality, and longevity of U.S. citizens is directly related to soil fertility. Devitalized soil, they claim, has resulted in a far less healthy population than we would have today if all of our foods had been grown on fertile soils since our country was formed.

If this is true, it is one of the most important but least understood truths in the world today. It is certainly one of the most controversial theories around. Edwin Malstrom, who was one of the founders of the federation, said that the strength of a nation is far more dependent on the fertility of its soil than on the size of its army, navy, or air force.

The intensity and intolerance of those who debunk the theory—and some of them have testified before this committee today—is matched only by the zeal and enthusiasm, and I might say the tenacity, of those who believe in it.

On the debunking side, we have gentlemen like the Harvard professor, Frederick Stare, M.D., who is a professor of nutrition. For more than 20 years he has pontificated that it is a great myth that soil depletion causes malnutrition and disease.

Now, Dr. Stare's deeply biased beliefs are repeated as though they were fully researched scientific facts by the U.S. Food and Drug Administration, the U.S. Postal Service, the Federal Trade

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Commission, the American Medical Association, and even the Arthritis Foundation.

However, to its credit, the U.S. Department of Agriculture has not in the past and does not now share in this belief.

Now, S. 1128 will indirectly increase curiosity and research on this ongoing debate. Although there is nothing in the language of S. 1128 which states that it will directly authorize research linking soil fertility to human health, it is easy to predict that when enacted, as I predict it will be, the new research will stimulate much more important research on the link between human health and soil fertility.

A hint of the link was reported in a clinical note in the American Journal of Proctology, volume 12, No. 1, in February 1961, and I have included that as exhibit No. 1. It has the interesting title, "Anti-Malignancy Factors Apparently Present in Organically Grown Foods," and it was in this prestigious and—to use the term used earlier today in this committee—both-feet-on-the-ground medical journal of the American Journal of Proctology.

It reports six people who had cancer, and after they had the cancer metastasized, some of them lived as long as 30 years when they were placed on organically grown food raised in gardens.

Now, this sounds ridiculous and people will give it the back of their hand and say, well, now this is really the classic granola statement. You will note that it was reported more than two decades ago in 1961 in this prestigious medical journal.

Now, to my knowledge, not a single experiment has been conducted by USDA, FDA, the National Cancer Institute, or any other Government agency, to see if the marvelous phenomenon reported by Dr. Collins could be repeated again under controlled conditions.

S. 1128 directs the USDA to inventory and assess existing research and existing materials, and to recommend new research that will help farmers achieve a better understanding of the ramifications of innovative farming practices. We would naturally expect one of these recommendations in the future to be for research on the link between soil fertility and human health.

Now, there are those who will ridicule the possibility that there could possibly be any link between soil fertility, pesticides, herbicides, and cancer. In the National Health Federation, we do not ridicule or defend health theories. We defend the right of those who have new ideas about old, unsolved health problems to bring them forth for debate, criticism, and additional research. Until we have the answer to cancer in this country, the jury is still out.

Now, probably an easier relationship than cancer would be to ask the question if anemia is related to soil fertility. Anemia is one disease which may be more easily proved to be related to soil fertility than cancer.

In our exhibit 2, we have a chart of the extremely wide variations discovered in the mineral content in vegetables grown on different soils. This was done by Rutgers University. Note, for example, that tomatoes grown on one soil have 1 part per million of iron, compared to tomatoes with 1,938 parts per million of iron when grown on a different soil.

Now, one way to emphasize the fantastic difference of iron content of tomatoes grown on different soil is to realize that an anemic

girl or woman would have to eat a tomato a day for more than 5 years that contained 1 part per million of iron to equal the iron she would get in a single tomato that contained 1,938 parts per million.

Is anemia a problem in America? It is a tragic problem of immense proportions that might virtually be eliminated by simply increasing the fertility of the soil on which tomatoes and other vegetables are grown without changing our diet one bit.

Now, exhibit 3 is taken from the preliminary report No. 3 of a nationwide food consumption survey taken in 1977–78, and published in January 1981 by the USDA. It reports that more than 10 percent of U.S. households are consuming food that provide less than the recommended dietary allowance for iron. More research is urgently needed to see if this problem can be corrected by increasing the iron content in vegetables by improving soil fertility.

There may be a link, and I strongly believe there is a link, between many other chronic diseases and the fertility of the soil on which our food is produced.

The National Health Federation urges enactment of S. 1128/H.R. 2714 to the end that this research will be done as soon as possible. Thank you, Mr. Chairman, for the opportunity to express our views.

Mr. HILL. Thank you, Mr. Miller. Unfortunately, we will not be able to put the tomato in as part of the record. [Laughter.]

Our last witness today is Terry Gips, who came in from Minneapolis, MN. He is the executive director for the International Alliance for Sustainable Agriculture, and we welcome him here today.

STATEMENT OF TERRY GIPS, EXECUTIVE DIRECTOR, INTERNATIONAL ALLIANCE FOR SUSTAINABLE AGRICULTURE, MINNEAPOLIS, MN

Mr. GIPS. It is an honor being here today.

I am Terry Gips, executive director of the International Alliance for Sustainable Agriculture, a nonprofit, tax-exempt organization of individuals and groups committed to the creation of economically viable, ecologically sound, socially just, and humane agriculture worldwide.

There are three major program areas of the International Alliance: (1) research and documentation of sustainable agricultural practices, (2) organizational support and networking; and (3) education and information dissemination.

We are funded by memberships, donations, grants, and the sale of slide shows and publications such as the bimonthly newsletter, Manna, and a monthly worldwide news information service, New Directions in Agriculture.

I welcome this opportunity to appear before you today, a place quite familiar to me, as I served as an aide to former Congressman, now Federal appeals courts judge, Abner Mikva, as well as agricultural legislative assistant to former Congressman John Krebs.

The perspective I would like to share with you is based on 10 years of experience in many aspects of agriculture and as an agricultural economist trained at the University of California—Davis and the Yale School of Management. I have worked as a cooperative extension adviser; economic analyst and grain merchant with

Cargill, Inc.; White House Domestic Policy and Intergovernmental Relations Staff Assistant; cofounder and director of the Sacramento Community Gardens Program; and author of a forthcoming book based on 2 years of travel around the world researching and documenting sustainable agriculture.

I presently serve as alternate board member of the International Federation of Organic Agriculture Movements, the National Steering Committee member of the Pesticide Action Network, and board member of the Midwest-based Organic Growers and Buyers Association and the Wedge Community Food Cooperative.

These diverse experiences have given me an indepth understanding of the promise and problems in developing a sustainable food system. After having visited and documented hundreds of biological, organic, regenerative, biodynamic, and other sustainable farms in 40 countries, it is clear to me that not only are such practices viable, but they may provide some badly needed answers to many of the problems we are facing with contemporary agriculture.

This was underscored at a just completed research colloquia on sustainable agriculture sponsored by Michigan State University, one of our Nation's leading land-grant universities.

The remarks of Dr. James Anderson, dean of the College of Agriculture and Natural Resources, summarized the importance of developing sustainable practices, as embodied in the Agricultural Productivity Act. I will quote him.

> We have given very little consideration to the externalities. We cannot continue at the present rate. We must look at a new technology that will be politically, socially, and ecologically acceptable. It is fortuitous that such technology is now available.

Today I would like to address two areas. First, utilizing the resources of the International Alliance for Sustainable Agriculture, I would like to provide an international perspective on some similar legislation and research being carried out in Canada and Europe. Once this is in context, I think you will see that this legislation simply makes good, sound economic sense.

Second, I would like to point out some of the undiscussed externalities so often neglected by economists in policymaking. In this case, however, I will take a really unusual step for an economist and point out several positive externalities that provide additional merit for this legislation.

As far as the first point is concerned, a number of countries have been funding similar investigations for up to 4 years, many of which have identical components to the Agricultural Productivity Act. Let us begin with Canada.

In 1982 the Ministry of Agriculture in Quebec began a 5-year program providing for research on 12 organic farms in Quebec, one in each of the 12 agricultural regions of Quebec. The purpose is to obtain baseline data on productivity and income, as well as to develop cost of production data to determine eligibility for government farm credit.

A wide variety of farm types were selected, from greenhouse and vegetable operations to dairy and grain. After 5 years, a report will be issued estimating the various costs of production for each speciality.

Since 1979, the German Government has made a major commitment to research in all aspects of sustainable agriculture. Professor Hardy Vogtmann of the University of Kassel provided a conservative estimate that at least 4.3 million deutche marks, or about $1.5 million, will be spent next year on public research and teaching in biological agriculture, as it is most narrowly defined. This excludes broader research in legumes and insect pests, for example.

This funding will provide for 6 experimental farms, limited research on 40 to 50 farms, and a sustainable agriculture extension service in each State throughout Germany.

The Swiss are spending approximately $650,000 a year on such research, including a major comparative trial of 20 paired organic and conventional farms and 25 unpaired ones. The costs were kept down by utilizing the farms' existing bookkeeping system, a practice which does unfortunately limit the research scope.

The project is 3 years old and the first report has recently been published. The results are quite favorable, and the program has thus been refunded for another 3 years.

Dr. Vogtmann estimated that Norway, Sweden, and Finland are spending approximately $1 million per year on sustainable agriculture research, which is being matched through private contributions. France has just begun a decentralized national institute of biological agriculture, and Austria spends approximately $180,000 per year on biological agricultural research.

One of the most impressive programs may be found in The Netherlands. The Dutch Government currently expends approximately 10 million guilders, or about $3 million, on biological agriculture, plus at least $3 million on legume research, according to Dr. Pieter Vereijken, director of the research program there.

The program includes a 72-hectare, or 180-acre, experiment farm, three experimental farms in preparation, onfarm inventory research, a low-energy animal farm, an education and extension with 2 full-time and 20 part-time extension agents. This is all in strictly biological agriculture, in addition to the normal government programs.

A $3 million annual expenditure is indeed a major commitment in a country with 15 million people and the size of New York State. Dr. Vereijken explained the rationale for this spending this way, and I quote him: "We were the first to feel the problems because we have a very advanced agricultural system. We want to continue to live with our land and have the world's highest yields." As many of you may know, they have extremely high yields, in most cases higher than in the United States.

He continued, "For this reason, we have made a major commitment to research in biological agriculture." With such a perspective, I think you can see why we feel the expenditure of $2.1 million for this bill is most reasonable, if not even less than is needed.

As an agricultural economist and a taxpayer, I am quite concerned that every dollar we spend on research achieves the highest return possible. This marginal rate of return is stabilizing at this point, and in some cases actually decreasing, after having poured hundreds of millions of dollars in certain areas of conventional research.

However, the potential rate of return in sustainable agriculture is very great, as we have only invested negligible amounts. Economic logic tells us we should increase our investment in such areas as sustainable agriculture until its marginal rate of return equals others.

This is not saying we should not invest in conventional research, only that research into sustainable practices must be expanded.

I would now like to address the area of externalities and look at three externalities. The first is that the provision of this funding will have a leverage effect. The bill will send a strong message to the research community that Congress believes sustainable practices are a priority, and the funding will encourage expanded research within the USDA and land-grant universities.

The simple existence of the Agricultural Productivity Act has already generated increased research interest at such land grants as the University of Minnesota. For a nominal amount, a great deal of leverage will be achieved, creating a far greater return.

Second, this bill will provide a major psychological boost to the many farmers who feel trapped on chemical financial treadmill. The passage of the bill has special importance for the approximately 30,000 organic farmers in this country and the thousands more who are seeking to establish more sustainable practices.

They have received minimal assistance in meeting their information needs and this bill represents an important first step in acknowledging the importance of providing this information and ensuring that the USDA will make it a priority.

By supporting this bill, Congress will send a strong message both to these farmers and the general public that it is concerned about the future of agriculture and our food supply, and that it is committed to investigating and developing sound practices that will allow them to continue farming into the future.

Third, this bill offers us the opportunity to maintain our image as the world's leader in developing new farm technology and practices. Our investment in research and development has reaped benefits many times over.

For this reason, countries around the world turn to us for leadership in agriculture, with consequent multiple benefits for our economy. They will continue to do so only if we are at the cutting edge with appropriate, sound practices.

In conclusion, we are now faced with serious economic, environmental, social and health issues related to our present form of agriculture. There are no quick, easy fixes or panaceas, but research into sustainable agriculture offers potential answers to many of the problems we are facing and will face tomorrow.

We must now make a choice, for we are at a crossroad. Either we can continue on the same path and allow the problems to fester to perhaps irreversible proportions, or we can choose to explore the new path offered by sustainable agriculture.

By supporting the Agricultural Productivity Act, we will be taking an important first step toward an agriculture with a future. A relatively small financial commitment will return itself manyfold and allow the United States to remain a leader in world agriculture.

Thank you, Mr. Chairman and subcommittee members.

Mr. HILL. Thank you, Terry.

On behalf of the subcommittee, we would like to thank all of you for coming teday and giving us your views on this bill. I would advise you that for those members who would have liked, if they could have been here, to ask you questions, we will submit those in writing for a written response.

I ask that the reporter show that the subcommittee now stands in adjournment.

[Whereupon, at 1:49 p.m., the subcommittee adjourned, subject to call of the Chair.]

APPENDIX

STATEMENT OF HON. JESSE HELMS
A U.S. SENATOR FROM NORTH CAROLINA

Today this subcommittee will hear testimony on S. 1128, the Agricultural Productivity Act of 1983. Though the purpose of S. 1128 is well intended, there are a number of questions concerning the bill that need to be addressed. However, I agree that there is much to be gained by exploring alternative and diverse methods of agricultural production.

Research and technology are constantly opening new fields of opportunity in agriculture. The innovations that are taking place, such a biogenetics, embryonic transplants, and the extraction of plant protein from green, immature plants, are mind-boggling in their implications for agriculture. We need to examine how these developments can be put to use to help our farmers diversify and increase their productive capabilities, as well.

Currently the United States Department of Agriculture is spending $18.8 million annually in research areas related to organic farming. Before deciding on any additional expenditures, we need to make sure that such costs are cost effective and not duplicative.

I also have serious reservations about the United States Senate establishing detailed scientific research projects, as defined in Section 5 of S. 1128. Instead, we should detail the areas that need to be addressed in the area of organic farming, and let the experts at the Department of Agriculture determine the scientific methods required to find the answers.

The United States Department of Agriculture continues to have a long-standing interest in organic farming and other methods of alternative farming. It is clear that the Department intends to continue the development of alternative systems within their overall program authority.

Everyone knows that agricultural technologies are widely diversified in this country and around the world. Surely no single mix of cultural approaches is best for all farms. Continued research on the applicability of various inputs into the production process is our best assurance of an economically viable and

sustainable agriculture in the United States. I support efforts to achieve this objective.

STATEMENT OF HON. PATRICK J. LEAHY
A U.S. SENATOR FROM VERMONT

Mr. Chairman, I am delighted that the Agriculture Committee will this morning examine in detail the Agricultural Productivity Act of 1983, S. 1128.

This legislation calls on the U.S. Department of Agriculture to conduct a research program to investigate organic farming systems. These systems avoid or minimize the use of nonrenewable resources, conserve soil and water, maintain or increase soil productivity, and yield high quality produce.

The House passed almost identical legislation (H.R. 2714) in January because of the hard work and leadership of Congressman Jim Weaver, who is with us here this morning.

Mr. Chairman, organic farming does not, as some charge, mean a return to the horse and buggy days of agriculture.

Nor does the employment of organic methods mean that 50 million people will starve, as a former Secretary of Agriculture once said.

Nor is it the "dead end" that the current Secretary of Agriculture claims it is.

Organic farming does represent a lower cost, more environmentally sound system of food production--one that deserves a careful look if we are serious about ensuring the long-term viability and sustainability of American agriculture, the most productive system of farming in the world.

Current conditions on the American farm are not good, Mr. Chairman. Farm debt climbed to $216 billion this year while a steady decline in farm land values has eroded the value of farm assets. Farm expenses exceeded farm income by $400 million in 1982. Net farm income dropped for three straight years during 1981-83, the first time this has happened since the Great Depression.

Forced by these difficult economic times to plant fence row to fence row, farmers often abandon conservation practices as too expensive and time consuming. While in the short run, this may enable farmers to stay in business, the longer-term consequences of these actions spell real trouble for our natural resource base.

Mr. Chairman, I do not pretend that organic farming systems are the answer to each and every one of the problems on the farm.

As matter of agricultural policy, however, we must investigate the potential that these methods hold for lowering farm input costs and maintaining long-term agricultural productivity.

In fact, in 1980, a USDA report called "Report and Recommendations on Organic Farming" found that even a partial shift away from energy-intensive methods of farming to organic systems would help alleviate the financial bind many farmers find themselves in today.

Many are interested in these methods, Mr. Chairman. Often the information is not readily available. I cannot go to a farm meeting in Vermont now without hearing about these methods or being asked why no more information is available.

That is why in April of last year, I introduced the bill before the Committee. I am pleased to report that 22 Senators, of both parties, have joined me as cosponsors of this legislation. One of them, Senator George Mitchell of Maine, is with us here this morning.

This legislation calls on the Department of Agriculture to conduct a two-part research program to investigate organic farming methods.

First, USDA would conduct a thorough inventory of existing research materials and assure Congress that those materials dealing with organic farming are available to interested farmers through the Extension Service.

Second, S. 1128 would establish 12 on-farm pilot projects. Farms would be selected in a manner that would cover the widest possible diversity of soil and climatic conditions. Each would be studied over a five-year period as it made the transition from energy-intensive agriculture to organic methods.

Net farm income, production costs, soil strength, water use, and other variables the Secretary determines necessary would be tracked over this five-year period.

At the same time, 12 additional farms already employing organic techniques would be examined.

This legislation also calls for the dissemination of the information gained from this research to interested farmers and others through the Extension Service.

Each year, the USDA would report to Congress on the progress the transition farms are making, with a summary report due at the end of the five-year period.

The cost of this legislation, $2.1 million per year for five years is minimal. In fact, it represents just 0.002 percent of the current agriculture research and extension budget.

Mr. Chairman, Congress has spoken on this issue before.

In 1977, we requested a report on organic farming, and in 1980, USDA produced the "Report and Recommendations on Organic Farming," which I alluded to earlier.

In October of 1980, and again in 1981, the National Research and Extension Users Advisory Board recommended that USDA initiate organic systems research.

Most recently, the USDA Agricultural Research Service in 1983 advocated a similar study.

USDA, however, has yet to begin such work.

Mr. Chairman, I know that the Department is examining individual organic techniques. But, these methods are being studied as small parts of larger research projects--hardly a focused effort.

I know, too, that small parts of four staff people's time at USDA are devoted to oganic work. But, together, this time represents just 80 percent of one full-time staffer. Again, this staff work, like the research, is not exclusively devoted to organic farming.

I noticed that USDA has placed an Agricultural Research Service person at Rodale Farms.

Mr. Chairman, these are all steps in the right direction, and I want to encourage USDA to continue. However, we need to look closely at organic farming systems, not just the individual pieces. We need research that focuses on how these pieces fit into a properly functioning system of food production. This information is critical to farmers who are considering how they might incorporate organic methods into their own operation.

USDA, in its role of provider of funding for basic agricultural research, must focus more of its attention on organic farming.

This is what S. 1128 calls for.

The cost of this effort is minimal and the benefits to American agriculture could be substantial.

I look forward to the testimony we will hear this morning Mr. Chairman, and want to thank you for holding this hearing today on this most important subject.

STATEMENT OF HON. WALTER D. HUDDLESTON
A U.S. SENATOR FROM KENTUCKY

Mr. Chairman, thank you for scheduling today's hearing on S. 1128, the Agricultural Productivity Act of 1983, and H.R. 2714, the companion House-passed bill.

I was pleased to join Senator Leahy and others in introducing S. 1128. The bill provides for a research and assistance program

to increase our knowledge, and facilitate the development, of innovative farming systems that conserve water and energy and ease soil conservation problems.

As we all know, farmers have been hit hard by the dramatic rise in the cost of energy and petroleum-based farm supplies over the past decade. Also, soil erosion on farmland remains a serious national concern.

These problems must be addressed if the amazing efficiency and productivity of U.S. agriculture are to be maintained. I believe the research and related activities provided for under S. 1128 and H.R. 2714 can contribute to meeting that challenge.

This hearing, which includes a wide variety of witnesses and viewpoints, will provide a sound basis for Committee consideration of the legislation. I look forward to reviewing the testimony of today's witnesses.

STATEMENT OF HON. GEORGE J. MITCHELL
A U.S. SENATOR FROM MAINE

Mr. Chairman, Members of the Subcommittee, I appreciate your providing me with the opportunity to testify this morning in support of Senator Leahy's bill, "The Agricultural Productivity Act" (S. 1128), of which I am a cosponsor.

All too often Congress puts aside issues which involve long-range planning in order to concentrate on issues, and to resolve specific problems, which require urgent attention. This tendency to react rather than to plan has earned the Congress some justifiable criticism. It comes from Americans who sense that government is failing to focus upon certain developing situations which in the future will be the sources of major difficulties for our country.

"The Agricultural Productivity Act," S. 1128, seeks to devote some needed attention to one such important situation.

Organic farmers in Maine make a persuasive case that conventional agricultural practice in this country may ultimately deplete our resources. Existing productivity, they argue, depends largely upon petroleum-based fertilizers, the rising cost of which is contributing to the demise of the family farm and to a decrease in the net profitability of our largest agricultural corporations. These Maine farmers assert that these fertilizers, along with other additives and tilling methods now being regularly employed, increase soil erosion and decrease soil productivity. Once a farming operation has become organized on the basis of such practices a farmer may become locked into them, fearing the decline in profits that would occur during the early years of a transition to alternative practices—ones which are more resource-efficient, land-conserving, and affordable.

Organic farming systems, as defined in this bill, constitute a combination of innovative farming practices that can be varied to fit a particular farmer's needs and objectives. These practices avoid the use of petroleum-based and other non-renewable additives, conserve soil and water resources, maintain or increase soil productivity, and produce high quality products. They also can lead to reduced costs of production, a necessity for today's farms, particularly the smaller, family-owned operations.

This bill would require the Secretary of Agriculture to organize, improve and make available the body of literature which serves to inform those who choose to gradually change to organic farming systems, and stipulates that as part of this effort, the Secretary shall conduct twelve research projects which would examine the transition process in a variety of farming situations.

In addition, the bill would authorize appropriations of up to $2.1 million a year for five years. This authorization would represent a tiny portion of the Department of Agriculture's research budget which, as Subcommittee members are well aware, now stands at over $1 billion a year.

Owing to the practical considerations to which I have referred and to the modest program which would be authorized by S. 1128, no one should be under the impression that passage of the legislation will revolutionize American agricultural practices. It will not. Those of use who are its supporters offer it as a modest, though meaningful, first step in what will be a long evolutionary process.

We hope to precipitate a significant increase in the visibility--within the overall program of the USDA--of the options being discussed and evaluated by farmers throughout the nation who desire to incorporate organic techniques in their existing operations. At a very modest cost, we can provide valuable assistance to members of a growing farm sector who desire it.

A number of thoughtful farmers have long acknowledged the long-term desirability of changing to organic farming systems. In recent years, both the Department of Agriculture and the Congress have become increasingly aware of the limitations presented by existing farming systems and the potential offered by alternative systems. In his introductory floor statement, the distinguished Senator from Vermont (Mr. Leahy) noted that USDA frequently has emphasized this potential in its advisories and reports over the past decade, and that the Congress on at least two occasions has urged USDA to give greater priority to research and development in this area.

Unfortunately, little appears to have been done. The objective of accomplishing a transition to organic farming systems remains unfocused in the agricultural community today and USDA has stated its opposition to even this modest effort to give the objective greater prominence.

The administration's views on this legislation are contained in an August 9, 1983 letter from the Deputy Secretary of Agriculture, Mr. Richard E. Lyng, to Chairman Helms. In an effort to assist the Committee in its deliberations on S. 1128, I asked six organic farming experts in Maine to consider the Department's views and to share with me their reactions. The responses I received follow my formal remarks and I respectfully ask that they be included in the Subcommittee's hearing record as part of my presentation.

At this point, I would like to share with the Subcommittee excerpts from these letters which I found particularly useful.

The Department argues that enactment of the bill is unnecessary, and cites research presently being conducted by state and USDA scientists which "will be providing a continually updated source of technological information to the Nation's farmers..." There follows, in the Lyng letter, a list of innovative practices under study. Omitted is any reference to, or comment on, Section 4 of the bill, which in my view is the most important of the bill's instructions to the Secretary: that he organize, publicize, and extend the findings of past and present research.

The response of Elizabeth (Beedy) Parker of Camden, Maine, (writing to me on behalf of the Legislative Study Committee of the Maine Organic Farmers and Gardeners Association (MOFGA)) to this is as follows:

> While the USDA may have research going on in crop rotations, improved tillage methods, etc., . . . this research is _not_ integrated and its results are _not_ reaching the public or the farmers for whom it is intended. Current USDA research in alternative agriculture is done piece-meal and out of context. We need to _see_ the effects of methods of soil, water, and energy conservation; use of organic fertilizers and conditioners; diversification of crops, etc., on _working_ farms, because all of these changes interact and influence each other.

Pam Bell of Biddeford, Maine, editor of MOFGA's monthly newspaper, takes up a similar theme:

> If we have learned anything in a century of biological research it is that everything is connected to everything else. To take one aspect of biological farming such as legume rotations and apply this practice to a farm that uses synthetic pesticides to control insects, weeds, or diseases tells us next to nothing about how effective legume rotations can be in combination with other alternative or biological methods of farming.

There is also this reaction from Professor Frank P. Eggert of the Department of Plant and Soil Sciences of the University of Maine at Orono:

> It is my opinion that there is an inadequate research base presently available to decide unequivocally whether or not alternative farming systems can compete with conventional farming

systems. We do not wish to debate the validity of the ARS contention that research is already underway to obtain information on crop rotation, tillage methods, erosion control, etc. Certainly these programs do relate to alternative farming systems, but are the programs of investigation designed to elucidate results directly applicable to the problems faced by the farmer who wishes to develop an environmentally sound system? If it is claimed that such is the case, where are these results and how have they been publicized?

The Department's letter of opposition to S. 1128 makes two further criticisms: First, that the "cost of the program would both exceed the proposed authorization level and the President's budget request;" and second, that the program of research outlined in the bill cannot be expected to produce statistically significant and unambiguous conclusions. Several of my correspondents had comments upon the irony of these two criticisms taken together, including Jay Adams of Dresden, Maine, MOFGA's Executive Director:

> USDA claims that the bill is cost prohibitive, and then criticizes it as being weak in survey design (too small a sample of test farms to produce meaningful data) and short in duration (four years, not long enough to produce unbiased results). It sounds as if USDA is telling us that to get its support we need more research, but to do that would cost too much money, so we cannot have their support.

All six of the experts whom I contacted on this matter were in at least partial agreement with the USDA's criticism of the research design embodied in the bill. In his comments, Robert Johnston, Jr., President of Johnny's Selected Seeds, Albion, Maine, concluded that this criticism is significant enough to merit opposition to the legislation:

> Pardon me for suggesting that the bill is like a "loaded question." It is known, and has been for decades, that the less chemically reliant, more conservation-oriented practices are desirable. We do not need more research to again point this out. What we need instead are talented, brave university and extension people who have the knowledge and courage to speak out for permanent systems and see to it that the practitioners, the farmers, get the point.

Clearly, Mr. Johnston and the Administration are approaching from entirely diffent directions the subject of transition to organic farming systems. In my view, both undervalue the overall purpose of Section 5 of the bill. The research process is formative even if it is not always conclusive. Professor David Vail of Bowdoin College in Brunswick, Maine, stresses this point:

> I have served as outside reviewer for a similar 5-year conversion study based upon a single farm in Pennsylvania (this was a study of the Brubaker farm, conducted by the Rodale Research Center). The findings of the study have much heuristic value: they provoke thought and generate hypotheses for further work. The problems, as several of the study's reviewers have argued,

some with attempting to disentangle the causes of the observed results and to generalize about the significance of the results. . . . The Rodale people are suggesting that this farm verifies the superiority of organic methods. They may be right. But the data does not prove that case. In sum, I am all in favor of "whole farm" demonstration projects for their heuristic value.

I have cited only a few of the thoughtful comments I have received from the experts on organic farming whom I consulted in the State of Maine. I urge Subcommittee members and the professional staff to consider their views in their entirety, and to call upon them for assistance in perfecting this bill.

In closing I wish to reiterate my belief that the primary accomplishment of this bill, if enacted, will be to lend shape and focus to ongoing efforts designed to achieve a transition in agricultural practice. The initiation of new research, authorized in Section 5 should provide the emphasis necessary for the Secretary of Agriculture to "organize, publicize, and extend," the findings of past and present research.

Finally, I wish to thank the distinguished Senator from Vermont, Mr. Leahy, for his leadership on this issue. His past actions and this bill testify to his foresight on agricultural matters and his dedication to assisting America's farmers. I look forward to working further with him and this Subcommittee in the effort to direct greater attention to organic farming methods.

MAINE ORGANIC FARMERS AND
GARDENERS ASSOCIATION

October 25, 1983

TO: Rockland office of Senator George J. Mitchell (Tom Bertocci)

FROM: Beedy Parker, for the MOFGA Legislative Study Committee

SUBJECT: S. 1128, "Agricultural Productivity Act of 1983," reply to USDA comments contained in letter to Senator Helms from Acting Secretary Lyng, dated 9 August 1983.

The USDA is opposed to attention being given to alternative agricultural methods and has refused funding for research in these methods, in spite of recommendations of their own advisors based on priorities established in the USDA's own 1980 Report on Organic Farming.

While the USDA may have research going on in crop rotations, improved tillage methods, etc., as mentioned in the letter, this research is not integrated and its results are not reaching the public or the farmers for whom it is intended.

Current USDA research in alternative agriculture is done piecemeal and out of context. We need to see the effects of

methods of soil, water, and energy conservation; use of organic fertilizers and conditioners; diversification of crops, etc., on working farms, because all of these changes interact and influence each other. Some of the savings in energy, water, and money may come as a result of efficient interactions between different farm operations. For example, the manure from livestock goes to fertilize crops instead of becoming a disposal cost or run-off pollution problem with cost to the surrounding community.

Where increased human labor and employment occur, we should be able to count this as a benefit rather than a cost. I think that one of our main problems in agriculture is the increasing mechanization of labor, which results in compaction of soil and loss of soil, depopulation of the countryside, concentration of ownership in the hands of a few, and over-capitalization of farms with resulting credit problems for farmers.

The five-year period allotted for the project is certainly short. Practices such as crop rotations, and reestablishment of hedgerows and windbreaks, and the gradual balancing of the farm ecosystem after reducing use of chemcial pesticides, would take longer than five years to show optimum benefit. With reasonable weather and good management, however, the five-year period should be adequate to show measurable soil improvement, crop health, and reduced costs. Five years is the period often mentioned as the time necessary to build up organic matter in the soil and to iron out the ecological imbalances created by heavy pesticide and chemcial fertilizer use. I imagine that there would be recommendations to continue these research projects beyond the five-year period; however, you have to start somewhere. One of the main reasons for using these alternative methods is the long-term benefits which accrue to the farm (in contrast to the cut-and-run profits which are easily measured in a short period), so the research period must be long if these benefits are to be measured. I think the USDA's criticism of "too short" is not an honest comment under the circumstances, since they clearly oppose this type of research.

The letter demands a larger sample. This might be desirable but would, of course, cost more, and the USDA complains of the cost. Again, they are thinking in terms of large numbers of discrete, precise experiments, whereas the workings of a real farm are too interdependent to be analyzed in this fashion. The complexities and number of interactions probably defy complete analysis. So careful matching of a large sample of pairs would have little meaning.

The letter mentions the value of "utilizing numerous locations to sample differnces in climate, soil, customs and other variables which have excellent direct educational and demonstration value to farmers." The progam could certainly be expanded beyond the 12 project farms if there is no USDA opposition.

The USDA letter says the program would cost seven to nine times as much as is budgeted. I can only guess that their interpretation must be quite different. They must not be taking into ac-

count the fact that existing farms will be used, with existing equipment, buildings, and cooperative farmers. They won't be starting from scratch and the project won't be a handout but a study of working, living operation. They don't have to set up a laboratory--it's already there!

Another reason for the "holistic" approach is that these farms would be better teaching devices than a scattering of experimental plots. Other farmers can learn better from a whole operation of a working farm. In Representative Weaver's testimony for H.R. 2714, "Such research focuses not just on the actions and reactions of specific farming practices, but also examines the intereactions by these practices used in the farmer's management system. By conducting systems research, the Department is better equipped to help farmers integrate into their operations that will enchance productivity and conserve their precious soil and water resources." (Cong. Record, 21 Apr 83)

Having the research done on whole farms provides a focus for the USDA, university agronomists, and the Cooperative Extension Service. It is easier to think about a particular place where something is being done by a particular group of people than to remember and try to integrate many separate pieces of research. The existing research by the USDA in alternative methods of agriculture is buried in haystacks of chemical research which is well funded by the companies that sell the chemicals and machinery used in "conventional" agriculture. We need working farms to focus our attention on, and to counter this enormous weight of chemical research and advertising. Conventional agribusiness has the money to promote methods of short-term high production, but little interest in long-term productivity. It is up to the government to champion alternative methods with the long view in mind.

October 24, 1983

Senator George J. Mitchell
387 Main Street
Rockland, Maine 04841

Dear Senator Mitchell:

Things appear to be moving on S. 1128, the "Agricultural Productivity Act of 1983" and we hope you will do all you can for the bill, and for organic agriculture, in hearings and on the floor.

We, like many others, are confused by the USDA's arguments in opposition to the bill. First, there is no substitute for actual on farm research, both in terms of scientific inquiry and to show ordinary farmers the advantages of a particular agricultural strategy. The pilot research project proposed in S. 1128 would augment, not duplicate, the work currently being done at USDA.

Second, USDA claims that the bill is cost prohibitive, and then criticizes it as being weak in survey design (too small a sample of test farms to produce meaningful data) and short in duration

(four years, not long enough to produce unbiased results). It sounds as if USDA is telling us that to get its support we need more research, but to do that would cost too much money, so we cannot have their support.

The fact is, our agriculture must become permanent, sustainable, resource efficient, land conserving, appropriately sized and powered if it is going to feed us in the long term. We must equip our farmers with the know how to put agriculture on a sound footing. Our great gains in productivity are of value only if they can be preserved.

The Agricultural Productivity Act of 1983 would help provide the guarantees farmers and consumers need. Please do all you can to secure passage.

Thank you.

Sincerely,

Jay Adams
Executive Director

R. R. 2, Box 365
Verona, Maine 04416
November 4, 1983

Honorable George J. Mitchell
United States Senator
387 Main Street
Rockland, Maine 04841

Dear Senator Mitchell:

This is in response to a request to forward an evaluation of S. 1128 (Agricultural Productivity Act of 1983) and the opinions given by the USDA in a letter addressed to Senator Jesse Helms.

It is my opinion that there is an inadequate research base presently available to decide unequivocally whether or not alternative farming systems can compete with conventional farming systems. We do not wish to debate the validity of the ARS contention that research is already underway to obtain information on crop rotation, tillage methods, erosion control, etc. Certainly these programs do relate to alternative farming systems but are the programs of investigation designed to elucidate results directly applicable to the problems faced by the farmer who wishes to develop an environmentally sound system? If it is claimed that such is the case, where are these results and how have they been publicized? How much support is presently being given to investigation of the problems associated with alternative farming methods?

Unfortunately, the demonstration approach as a research technique does not impress me very favorably. A demonstration implies that we already know what should be done and the primary

need is to show how a system can be set up. The problem that needs elaboration is that we do not have adequate data obtained over a wide array of environmental circumstances so as to be able to predict with a high degree of certainty that a specific result will occur. Consequently, I must agree with the USDA argument that the concept of the demonstration approach is questionable. To do nothing however, is not a solution anymore than continuing the same emphasis on conventional techniques will provide the answers to the problems of alternative farming systems.

During the past eight years I've been associated with the problems of alternative system farmers as well as those of family farms. In discussions with these farmers we have frequently talked about the Land Grant institutions efforts in international agriculture (primarily third world). Most small farmers agree that the farm system or holistic approach as a means of improving production efficiency is logical. They have consistently responded by questioning why the same approach is not logical in American agriculture. The real question then is how to synthesize a self-sustaining unit of operation which is unique for each combination of farm, farmer, soil, environment and the associated biomass which makes up this unit of production.

In summary S. 1128 findings and purposes detail very accurately the needs of alternative farming systems (and probably U.S. agriculture, in general) and should be supported. I would propose that a limited number of research farms be supported with the specific objective of investigating the problems associated with transition from conventional farming methods to alternative farming methods in a holistic system. The details should be left to the best judgment of the researchers who must be held totally responsible for identifying the variables and their limits, leading to a sustainable long-term production system.

Sincerely,

F. P. Eggert,
Professor of Horticulture

Pam Bell
RFD #3, Box 382A
Biddeford, Maine 04005

Re: The Agricultural Productivity Act of 1983.

Senator George Mitchell
387 Main Street
Rockland, Maine 04841

Dear Senator Mitchell:

First, let me explain that though computer prepared, this is certainly not a form letter. Second though a little difficult to read, without the computer system, I would not have time to respond adequately to your request for comments on S. 1128, the "Agricultural Productivity Act of 1983".

It is my feeling that S. 1128 is a good bill, and it is my belief that if the bill should pass it will be a good start toward the vast amount of alternative agriculture type research that is so badly needed in order to assure a healthy and productive U.S. agriculture for the 1980s and beyond.

S. 1128 proposes agricultural research that is both appropriate and unique to alternative agriculture methods. First, the bill attempts to devise a research approach that looks at whole systems rather than at individual aspects of farming. While this may seems to give us data that applies to only one or a dozen individual farms, it is nonetheless essential since biological or alternative agricultural methods are rarely effective when applied one at a time. It is, in fact, exactly that isolation approach which has, in the past, identified alternative agriculture methods as ineffective and yet the USDA Report on Organic Agriculture found that farms which employ several alternative agriculture techniques are both economically and biologically productive.

If we have learned anything in a century of biological research it is that everything is connected to everything else. To take one aspect of biological farming such as legume rotations and apply this practice to a farm that uses synthetic pesticides to control insects, weeds or diseases tells us next to nothing about how effective legume rotations can be in combination with other alternative or biological methods of farming With alternative agriculture, the whole is more than just a combination of parts. Therefore in order to evaluate, understand or learn how to apply alternative agriculture, we must look at whole systems.

Through research conducted by Maine's Soil Conservation Service and others, we have learned that erosion has a negative effect on productivity. Specifically, with a soil loss of 0 to 12 tons per acre on potato fields consisting of Caribou soil, a yield reduction of 2.3 hundredweight per acre per ton of soil loss can be predicted. This amounts to about a 1 percent yield reduction for every ton of eroded soil. It is becoming widely recognized that in order to maintain productivity, we must control soil erosion. There is, however, more than one way to do this.

Conservation tillage, which is wholly dependent upon herbicides mainly paraquat, is widely researched, accepted and adopted as a solution to our soil erosion problem. Conservation tillage is, perhaps, lulling USDA, researchers and farmers into a false sense of security. We have learned through research already done that herbicides, for example, have an identifiable effect on the soil structure and on crop disease relationships as do crop residues that remain in the field under conservation tillage practices. We also know by observing the long term effects of herbicides as they have been used on U.S. farms, that plants become resistant to herbicides just as insects become resistant to insecticides so that new chemicals and new types of chemical compounds are constantly needed to counteract the natural biological responses of organisms to their environment. Conservation tillage can only be a temporary solution to soil erosion problems, a solution which, while saving soil, may be jeopardiz-

ing human health and the health of the environment as new toxic compounds are needed, developed and used.

Perhaps one of the greatest advantages to alternative agriculture, or agriculture which is not wholly dependent upon synthetic chemicals, is that alternative agriculture controls soil erosion and therefore maintains productivity without the unquestionably dangerous side effects of toxic chemicals And alternative agriculture controls erosion through a system that is biologically stable and therefore permanent and sustainable. Likewise funds spent on alternative agriculture research, unlike the millions of dollars spend on conservation tillage research, provides us with information that is more than temporarily useful.

The Senator should not be discouraged by USDA's opposition to the Agricultural Productivity Act of 1983. USDA's estimate that S. 1128 will cost $14.3 million compared with the ARS 1983 projected expenditures of $18.8 million on "research areas related to organic farming", may or may not be accurate. The point is that if ARS research does not look at organic farming as a system, but instead looks at different areas related to organic farming, ARS research will learn very little that is useful.

It is true that five years is too short a time to determine the true and lasting value of biological agricultural systems However, the same thing could be said of any agriculture research. Five years is also too short a time to determine the true and perhaps not-so-lasting value of conservation tillage Five years has certainly proven to be too short a time to determine the not-so-lasting value of conventional or non-organic agriculture.

A seven-year rotation in a biological agriculture system may eventually prove the idea, but a four-year system in my estimation, will provide data that is neither biased nor unfavorable. In four years a farm should be able to make the switch and be no worse off economically or managerially than prior to the switch. At the end of the four year time period, the farm should be largely free of having to rely upon increasingly expensive energy intensive practices and materials. Though improvements may continue to be observed in subsequent years, there are plenty of U.S. farmers out there who have successfully made the switch in three or four years.

If this response is not already too long for the Senator, let me just add a few words about the information search aspect of the bill. I have personally worked with Maine's Cooperative Extension Service (CES) on a project intended to provide Maine s organic farmers and aspiring organic farmers with information useful to their type of enterprises The main thrust of this project was a proposal from the Maine Organic Farmers and Gardeners Association in July of 1981 which requested the addition to the CES staff of an Extension Specialist in Organic Agriculture. The proposal further requested that information relative to organic agriculture be made available to the general farming and

gardening population through the regular and established channels of CES information dissemination.

CES judged that the staff addition would be both too costly and too likely to restrict distribution of information only to those already committed to organic agriculture. CES did, however, commit a dozen or so existing staff to a literature search for information pertinent to organic soil and pest management and to development of an on-going program to update findings and to distribute such through the county CES offices. Such a program can and should be developed in each state, but if each state must perform its own literature search, that makes for a lot of duplication of effort.

The information search proposed by S. 1128 would save a great deal of time and money at the state level and would have the added benefit of allowing the Secretary to learn first hand what information is available, what information is lacking and what research and education is needed to fill those gaps. In addition, most states do not have sufficient university funds to revise and reprint USDA publications. It is interesting to note that there is no USDA publication available today on the subject of green manures.

It is my hope that all or some of the above will be helpful to the Senator as he acts to support S. 1128, the Agricultural Productivity Act of 1983. If you have any questions, or if I may be of further help, do not hesitate to call.

Sincerely,

Pam Bell, Editor
Maine Organic Farmer and Gardner

P.S. The STEEP research project (Solutions to Environmental and Economic Problems) is a long term, three-state (Washington, Idaho, Oregon), multi-discipline attempt to find a solution to the soil erosion problems in the Pacific northwest. A total of $435,000 has been provided annually to ARS for STEEP since 1976. In addition, STEEP has received a special USDA grant to the three experiment stations ($250,000 in 1976 raised gradually to $648,000 in 1982). Conservation tillage is the solution to soil erosion upon which STEEP has concentrated.

Bowdoin College,
Department of Economics
Brunswick, Maine 04011

Senator George J. Mitchell
c/o Tom Bertocci
387 Main Street
Rockland, Maine 04841

Dear Senator Mitchell:

It is most encouraging that you have chosen to co-sponsor the "Agricultural Productivity Act of 1983" (S. 1128). I am pleased that Tom Bertocci has asked me to comment on the Bill and USDA's criticisms of it (contained in Richard Lyng's 9 August, 1983 letter to Senator Helms) It is especially encouraging to know that I may be able to support policies for a sustainable agriculture through collaboration with your office. In the past, I have only been able to offer support indirectly by backing the Institute for Alternative Agriculture, MOFGA and the National Family Farm Coalition.

Considering that USDA under Secretary Block terminated funding for its organic farming office, the defensiveness of Mr. Lyng's letter is not surprising. While on the whole I do not find its response to the bill persusaive or constructive, the letter raises two points which are valid and which should be acknowledged. The first of these regards USDA-supported research which is already underway. The second point relates to real defects in the conception of the twelve farm pilot research study. I will comment on each of these issues in turn.

The first paragraph of Lyng's letter stresses the broad range of current USDA research on subjects with ecological dimensions. This contention is correct, but it begs the key question. The piecemeal nature of funding decisions for research projects and the reductionist (i.e. narrowly focused) orientation of most American agro-scientific investigations give rise to fragmented findings. Thus while many distinct parts of the ecological mosaic of agriculture are investigated, they do not add up to a whole: a big picture". A <u>coherent</u> USDA research program, stressing the subtle interactive effects of many different biological, chemical and mechanical practices, does not exist. Neither does a <u>systemic</u> approach to the analysis of the individual farm as a complex system with ecological impacts. I could speculate at length about why these research biases prevail, but in a nutshell, three forces seem to be at work: first, the dominant reductionist/empiricist view of scientific methods "learning more and more about less and less"); second, the orientation of many researchers to publication in "reputable journals" rather than solving important real world problems; and third, the impact of agribusiness corporations cost sharing of land grant college research, linked to their present or prospective production markets.

In paragraph seven (7) of Lyng's letter, he claims that a more holistic approach to agro-ecology <u>is</u> being studied via inter-

disciplinary projects. It would be interesting to see a roster of these projects and their share of USDA research funding (particularly the change in their share of funding over the past three years).

Before commenting upon the pilot research project mandated by S. 1128, I want to put my support behind Section 4, 5(C)(6) and 9 of the bill, which require USDA to synthesize, publicize and extend the findings of past research into various ecological aspects of agriculture. My work with University staff, extension agents and farmers throughout the Northeast (and especially in Maine) convinces me that there is a wealth of scientific and practical knowledge from past research which is simply unknown or not understood by practitioners For example as a group, Maine s county agents do not strike me as particularly competent to advise farmers on composting manures for nutrient conservation or on the use of crop rotations for weed and pest control or enhancement of soil nutrient availability. The catch--as Mr. Lyng correctly stresses in paragraph two of his letter--is that the critical tasks are costly. They include interpretation and synthesis of findings, dissemination of findings and upgrading of extension capabilities. My sense is that this would be a valuable use of taxpayers' money. But it is rather fatuous to mandate such actions without explicitly funding them (especially given USDA's manifest bias against a change of policy in this direction).

I have saved for last what I consider to be the most problematic part of S. 1128: the proposed twelve farm (matched pair) pilot research study. It is my sense that five of Mr. Lyng's criticisms of the study, contained in paragraphs 3-6 of his letter, are valid.

1. "The statistical basis is weak. There needs to be a larger sample size . . . to achieve acceptable . . . confidence in the results." Even twelve relatively homogeneous farms are a narrow base from which to draw confident conclusions. But when it's two dairy farms, two cash grain farms, etc., the findings are bound to have virtually no broader applicability.

2. "The bill as written is restrictive, leaving the scientists and research managers little opportunity to design the studies in ways to produce results more meaningful . . ." Is it common for Congressional representatives to stipulate the details of scientific investigations?

3. "large diversity in farm size, soil type and climate characteristics . . which could be thought to be an advantage by some . . . would dramatically complicate the research and could likely result in data of minimum value." With so few farms under observation there are simply too many uncontrolled variables clouding any attempt to analyze cause and effect relationships associated with different farming methods.

4. "a five year period . . . is much too short for the anticipated changes to occur."

5. "If it is necessary to study whole farm systems, it must be recognized that the combinations of logical choices (of production methods) by farmers who use either conventional or alternate farming systems are many." Thus, a twelve farm study is bound to be quite biased in its selection of which techniques to study; there is no way to tell beforehand which is the "definitive" nonconventional system to investigate.

   (By the way, given USDA's clear opposition to this research idea, it is problematic to turn over the implementation and data analysis to them!)

The basis of my skepticism is an experience over the past few months. I have served as outside reviewer for a similar 5-year conversion study based upon a single farm in Pennsylvania. (This was a study of the Burbaker farm, conducted by the Rodale Research Center.) The findings of the study have much <u>heuristic</u> value: they provoke thought and generate hypotheses for further work. The problems, as several of the study's reviewers have argued, come with attempting to disentangle the <u>causes</u> of the observed results and to <u>generalize</u> about the significance of the results. This is partly the inevitable difficulty of generalizing from a farm which has highly specific topography, soils and climate conditions. But it also involves the empirical difficulty of distinguishing between the impact of particular organic farming practices on the one hand the unique human resources of the farm (the skills and management abilities of the operators) and the unique history of land use on that farm. The Rodale people are suggesting that this farm verifies the superiority of organic methods. They <u>may</u> be right. But the data do not <u>prove</u> that case.

In sum, I am all in favor of "whole farm" demonstration projects for their heuristic value. But I share USDA's reservations about how much can be learned from a tiny sample of twelve farms over a short period of five years. It is not clear to me that the project described in S. 1128 would be "cost-effective" use of taxpayers' money. I know that a $2 million spending authorization is awfully trivial these days, but I cannot help thinking that even such a paltry amount could be better used to support a sustainable agriculture in some other way.

Despite my mixed feelings about parts of S. 1128. I am greatly encouraged by the growing support for a regenerative agriculture. So far as my skills and time allow, I will be happy to work with you on future legislation.

Sincerely,

David J. Vail,
Professor of Economics

November 14, 1983

Honorable George J. Mitchell
United States Senator
387 Main Street
Rockland, Maine 04841

Dear Senator Mitchell:

Your Field Representative, Tom Bertocci was kind enough to send me a copy of S. 1128 Agricultural Productivity Act of 1983", along with the Department of Agriculture's August 9, 1983 negative response. I understand that you are a co-sponsor of this bill, and would appreciate my comments. Thank you. I am honored to have the opportunity to provide them.

I was familiar with this bill before its extensive re-write. My awareness of it ties in with my longstanding involvement with the Maine Organic Famers and Gardeners Association, MOFGA. As you may know MOFGA has an active legislative Study Committee which brought this bill to the attention of MOFGA's Board of Directors. Briefly, MOFGA as an organization has been in support of this bill, not surprisingly, since one of MOFGA s objectives is to promote the practice of sustainable agriculture. I have personally maintained a neutrality right along because of my not being well-informed of the details of the bill. Now that I have read the copy of it sent to me by Tom Bertocci, I can express an opinion.

I am opposed to the bill. I am a supporter of the organic agriculture approach, both as an individual, and through my seed business. Our farmland is too irresplaceable to be taken for granted. But I doubt that the methodology in the proposal would provide very much concrete information reliable over a wide range of locations, environments, and cropping systems.

I can expand on part of the Department of Agriculture's August 9, 1983 response and express an opinion that the system capable of being most influential on our environment and health, as it is effected by agriculture, is the Extension Service and the more localized research of the state land grant institutions. Obviously, the greatest effect on the environment is engineered by the individual practitioners, the farmers themselves Next in strength of influence are the entities which most directly effect the farmers decisions On a governmental level, this would be the local extension and local research upon which the agents draw, as well as other localized branches of the federal system, such as our Soil Conservation Service county offices.

Further, I do not believe that the sort of comparative research inherent in the proposed bill is novel in any way. By simply scanning USDA yearbooks over the past 50 or so years we find that the basic comparative research on legume plowdowns crop rotations, use of animal manures, and mechanical cultivation has already been done. With budgetary considerations we cannot afford to spend tax dollars reinventing the wheel, and proposals should be scrutinized for this possibility.

I agree with Section 2 of the bill in its entirety, including Section 2(5) which makes an appeal for research directed towards sustainable practices and systems. I do not believe, however, that Section 3, the purpose of the Act, would be accomplished with the methodology in the proposal. Pardon me for suggesting that the bill is like a "loaded question". It is known, and has been for decades, that the less chemically reliant, more conservation-oriented practices are desirable. We do not need more research to again point this out. What we need instead are talented, brave university and extension people who have the knowledge and courage to speak out for permanent systems and see to it that the practitioners themselves, the farmers, get the point. 2.1 to 14.3 million dollars a year (the cost range of the proposal vs. the USDA's assessment) could be more effectively spent to attract more talented state and county level personnel, and to bolster the technical assistance programs with additional staff.

Thank you for giving me the opportunity to express an opinion on this bill. I appreciate your co-sponsoring it, which demonstrates your concern for these issues. Please feel free to contact me anytime with specific questions on this matter, or in the future regarding any agricultural or horticultural topic.

Truly yours,

Robert L. Johnston, Jr.
President

STATEMENT OF HON. JAMES WEAVER, A REPRESENTATIVE IN CONGRESS FROM THE FOURTH DISTRICT OF OREGON

Thank you, Mr. Chairman. It is a pleasure to be here this morning to testify before this Subcommittee in support of the "Agricultural Productivity Act."

S. 1128 and H.R. 2714 were introduced jointly by Senator Leahy and myself, together with 12 other Senators and 50 other House Members, in April 1983. H.R. 2714 was the subject of three hearings and two mark-up's in the House Agriculture Committee, and was passed by the full House on January 26 by a vote of 206-184.

I believe this bill is extremely important for the future of agriculture. It provides for a modest, but urgently needed research and extension program that the Congress and the Department of Agriculture's own experts and advisers have been recommending for the past four years.

The 24 research projects established by the bill are designed to examine, within the context of modern agricultural technologies, farming systems that can help farmers battle the three greatest production problems they face today: skyrocketing production costs, dwindling water supplies, and rampant erosion.

Most importantly, the bill employs the same type of "systems" approach to the research projects which the 1983 Agricultural

Research Service Six-Year Implementation Plan recommends. Although USDA currently does some research which is related to the types of projects in the bill, the Department's own study team found that work is fragmentary and piecemeal. The on-farm, systems approach adopted in S. 1128 and H.R. 2714 is needed to tie these loose ends together. It will provide our farmers with much-needed information--not currently available--that can be integrated into their existing operations as they see fit.

In April 1983, Agricultural Research Service Administrator Dr. Terry Kinney wrote me to report that USDA had not performed any such "system" research and had no plans to do so until at least 1990. Thus, despite the well-recognized need for this type of research, and the specific recommendations of Congress and the Department's own experts, USDA has consistently refused to implement any research programs like those contained in S. 1128 and H.R. 2714.

I would like to point out that H.R. 2714, as introduced, did have some bugs in it. Those problems were resolved, however, when the USDA agreed to language giving the researchers additional flexibility in designing and carrying out the projects in order to ensure that the data obtained would be statistically valid.

Finally, Mr. Chairman, the potential benefits of this bill far outweigh its costs. S. 1128 and H.R. 2714 could cost only $2.1 million per year for five years -- less tha two-tenths of one percent of the billion dollar research and extension budget at USDA. I strongly urge the Senate of move quickly and pass the "Agricultural Productivity Act" this year.

STATEMENT OF

DR. ORVILLE G. BENTLEY

ASSISTANT SECRETARY

OF

SCIENCE AND EDUCATION

U. S. DEPARTMENT OF AGRICULTURE

Mr. Chairman and members of the Subcommittee, we appreciate the opportunity to participate in this hearing on S.1128, the Agricultural Productivity Act of 1983.

Over the past few months there has been a great deal of interest expressed by the Congress and the public in this legislation, including the comparable measure, HR. 2714, which has been passed by the House of Representatives. The Department has expressed its dissatisfaction with HR. 2714 and, as a result, criticism has been set forth implying that USDA was opposed to organic farming.

Let me take the opportunity right now to once again reiterate that USDA is by no means opposed to organic or other alternative farming methods. We are presently expending some $18 million annually in support of research activities which will benefit the organic farmers as well as the farmer who is looking for ways by which chemical in-puts can be reduced.

Over the years the American farmer has been able to achieve record productivity through the use of modern farming methods which include the use of farm chemicals. These chemicals, which are governed by stringent regulations, when properly used, make it possible for the farmer to make a profit. This, in turn, provides the consumer with an ample supply of food at a reasonable price.

Mr. Chairman, before addressing the legislation under consideration here today, I would take just a few minutes to point out that USDA has broadly-based authorities to conduct the agricultural research and extension education programs advocated in this legislation. USDA and State scientists are conducting research which provides a continually-updated source of technological information to the Nation's farmers. These efforts apply to the concerns and

problems of producers regardless of the farming system they choose to use.

Our Nation's publicly supported agricultural research and extension education system is unique. This system, which has worked so effectively for many decades, combines a centrally directed Federal research institution within USDA with strong, independent, yet responsive State institutions engaged in research and extension education programs that address the needs of agriculture and rural America. The knowledge gained from this system provides a scientific basis for developing new technologies to increase or maintain agricultural productivity.

It is the primary responsibility of the Agricultural Research Service (ARS) to conduct research on problems that apply to agriculture on a regional or national scale. Factors are identified that limit production regardless of farm size, management system used, or other unique characteristics.

The State agricultural experiment stations (SAES) respond to local, State, national and international needs, covering all the agricultural sciences including food, soils, water and other natural resources, plant and animal sciences, economics, and the social sciences. The Cooperative State Research Service (CSRS) provides the linkage between Federal and State components of the cooperative agricultural research system.

Recent advances in computer technology have increased the capacities of Federal and State scientists to deal more effectively with complex agricultural production systems. Understanding the interrelationships among the variable parts of these systems requires research on the biological and physical processes of farming systems. This research must be conducted under a wide range of soil, climate, and crop conditions, to provide basic data for application of models or other analytical methods to specific production systems.

Thus, by focusing on individual components and interactions among them, research findings can be integrated into numerous production systems whether they are "organic" or conventional, small or large, on a major commodity or a specialty crop. It should be noted that this interactive approach is being used by both

State and Federal scientists.

ARS and the SAES conduct research that provides basic information for alternative or "organic" farming systems. For example, in the area of biocontrol of pests, researchers are finding natural biological enemies of insects, diseases, and weeds, and are developing ways to manage them to increase productivity. Examples of research on insect biocontrol studies includes using microbial insecticides at the USDA Insect Pathology Research Unit, Brownsville, Texas; coddling moth control by virus by University of California scientists; beet armyworm control research at Auburn University; and pathology research at the University of Georgia, University of Illinois, and other institutions.

In the area of conservation tillage, cultural and management practices are being developed by Federal and State scientists that emphasize use of crop residues to protect soil from erosion. New research is required to resolve problems of nutrient status, weed control, diseases, and soil physical condition. Extensive research is underway on improved germplasm for resistance in plants to diseases and insects; development of plants that grow rapidly and competitively with weeds in altered ecological conditions produced by residues, no-till planting, intercropping; plants and associated organisms that fix large amounts of nitrogen from the air, and plant products having high nutritional value.

Immediately applicable information from ongoing research on crop rotation systems is available in numerous States where experiments have been underway for many years and several cycles of crops. For example, experiments initiated in 1967, at the Lancaster Experiment Station, in Wisconsin, contain the essential plot treatments needed for comparisons of crop yield resulting from different cropping sequences. The effects of these different cropping systems usually require several years to be expressed. Data of this type provide the basis for cropping system models and for farmers' decisions as to the technologies they will adopt.

I call to your attention that in April 1984, a cooperative research program was established between ARS and the Rodale Research Center in Emmanus, Pennsylvania. The cooperative arrangement includes placement of an ARS soil scientist at the

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Center for up to 3 years to work with Rodale scientists and to serve in a liaison capacity with a network of collaborating ARS and University scientists across the United States. In addition to this new research project, ARS conducts extensive soil and crop research programs throughout the United States that relate to organic farming and other alternative farming systems.

The Extension Service is responsive to the needs of people with programs addressing local and/or State problems as determined by various citizens' advisory boards. Although the educational programs generally are not labelled as specific to the use of synthetic chemicals or natural materials, many programs components are applicable to both the traditional (with synthetic chemicals) and the alternative systems of agricultural production.

Extension programs emphasize the conservation of natural and non-renewable resources and the protection of the environment through appropriate production practices. Crop production programs include: selection of varieties resistant to diseases and other pests; adaptation of varieties to climate, soils, and management; value of soil organic matter and its conservation or increase; pest monitoring and control through integrated pest management (IPM) systems; irrigation and water use to minimize environmental pollution; and others. Gardening publications include topics on composting, soil amendments, and use of manures and other organic materials. Pest identification is included, although pest control by use of synthetic chemicals is usually presented in separate fact sheets.

The National Agricultural Library (NAL) provides information on alternative agriculture or "organic" farming, along with the Extension Service. The Quick Bibliography series, based on searches of NAL's automated bibliographic database, AGRICOLA, has been an important vehicle. Sixteen titles relate directly to resource conserving crop production systems including, for example: Double Cropping and Inter-planting; Composts and Composting of Organic Wastes; Organic Farming and Gardening; Minimum/Zero/Conservation Tillage; Nitrogen Fixation in Soybeans; Allelopathy (the harmful effects of chemicals produced by one plant upon another); Cropping Systems; Integrated Pest Management; Legumes

in Crop Rotations; and others. Also, NAL selects published materials to augment the collection of literature relating to all the alternative approaches to agriculture.

The CSRS has a cooperative agreement underway with the Iowa Agricultural Experiment Station to evaluate the agricultural research projects in USDA's Current Research Information System (CRIS) with regard to farming systems research. The study found there are roughly 20,000 State and Federal projects having FY 1982 data and approximately 40% of them are relevant to farming systems research. Of these, 85% are applicable to both "organic" or alternative farming and conventional farming, and 3% have a special applicability to "organic" farming. This study will provide invaluable information on many aspects of agricultural production systems and help USDA, and the States, to better identify areas of needed research.

I will now make some comments more specific to S. 1128. Enactment of the bill and the appropriation of authorized funding levels would exceed the President's budget request and could require the Federal and State extension services to develop new programs that are duplicative and unnecessarily costly.

Section 5 provides for 12 pilot projects on four different types of farms to examine the effects of a transition from use of synthetic or chemical systems to alternative "non-chemical" systems. The conditions of selection, the subsequent treatments, small sample size, and the omission of "conventional" systems makes the statistical base weak for needed comparisons.

The bill as written is restrictive, leaving the scientists and research managers, who are located where the research would be conducted, withoutthe flexibility to design the studies in ways to produce more meaningful results in responding to the objectives and problem needs. The specified time frame of 5 years is much too short for the anticipated changes to be expressed. With the first year "specified" as a data base establishment year, only four remain for measurement of effects. Then, if a four-year crop rotation is employed, for example, only one cycle could be completed, and biased data would result. The bias would likely be unfavorable to the alternative farming system.

It must be recognized that the combinations of logical choices by farmers who might use either "conventional" or alternative farming systems are many. This complicates the research and the interpretation of data. Subsequently, unless the research utilizes sound statistical procedure, the application of conclusions to real world conditions would be questionable. Problems of changing farming systems, however, can and are being researched in carefully planned interdisciplinary projects.

Let me emphasize that the research and extension education arms of USDA and the cooperative State institutions are very concerned about the high cost of production faced by farmers. We are committed to continuing research and education activities to address the problems of all farmers. To combine all the variables comprising a farming system in a research project is an imposing task. Not only is it difficult and expensive, only one "system" of many possible options would be evaluated in each unit as described in this bill.

In summary, while we are sympathetic to the purposes of S. 1128, and supportive of organic farming research, we remain opposed to the enactment of this legislation because of the restrictive requirements on the conduct of research, coupled with the fact that USDA is already addressing the concerns set forth in this bill. And, Mr. Chairman, we would point out that this bill authorizes the expenditure of $10,500,000 to implement the provisions which it contains. This is a significant amount of money at a time when we are all concerned with the ever-growing Federal deficit. This Administration cannot, in good conscience, support such an increase in organic farming research.

Mr. Chairman, this completes my prepared statement. I will be pleased to respond to questions or refer them to our USDA resource scientists.

STATEMENT OF GARY D. MYERS, PRESIDENT
THE FERTILIZER INSTITUTE

Mr. Chairman, The Fertilizer Institute is pleased to respond to your invitation to present testimony related to Senate Bill 1128, entitled the "Agricultural Productivity Act of 1983."

The Fertilizer Institute is a voluntary, non-profit association whose members represent approximately 95 percent of the domestic fertilizer production in the United States. The Institute represents over 320 members including producers, manufacturers, traders, retail dealers and distributors of fertilizer and fertilizer materials. Its members are major shippers, receivers and exporters of fertilizer and fertilizer materials, and a vital link in America's agricultural food chain.

We cannot recommend support for the bill, not because we are against agricultural productivity -- indeed, the fertilizer industry has been a major contributor to productivity; not because we are against well-structured, sound agricultural research -- and soil conservation efforts -- indeed, the fertilizer industry has been a major supporter of such research throughout more than a century; and not because we disfavor use of animal wastes, crop residues, green manures and other materials commonly known as organic -- indeed the fertilizer industry for years has encouraged incorporation of organic matter in soils for soil structure improvement, erosion control and the limited nutrient contributions available.

Rather, a careful review of S.1128, in view of well-established facts, shows that the premise of the legislation is ill-founded. Unfortunately, we feel that the research

money requested under the bill would provide inconclusive results, at best; and, at worst, be a $10.5 million waste.

Although S.1128 does not use the term "organic farming", as such, it has become known as an organic farming research bill, along with all the mystique and misconception which that term often brings to mind.

Mr. Chairman, let me lay out for the Committee some facts regarding nutrient use by plants.

Life processes, whether in green plants or humans, have certain basic requirements. For example, there is no protein without the nutrient nitrogen, no adenosine triphosphate (ATP) without phosphorus, and no carbohydrate metabolism without potassium. When nutrients such as these are lacking or deficient, life processes are cut short.

In plants, the results of such nutrient deficiencies are low crop yields. Not until late in the 1800s did people begin to understand this, and then start to supply these nutrients through commercial fertilizer use.

<u>What are Commercial Fertilizers</u>?

By definition, commercial fertilizers are products used primarily for their plant nutrient content. In the case of nitrogen fertilizers, the nutrient is produced by combining nitrogen from the air, and hydrogen, which is derived largely from hydrocarbons, such as natural gas. Phosphate and potash, and most other nutrients are mined products, treated and refined for efficient use by agriculture. Their sale is regulated by state fertilizer control laws which require that fertilizers be labeled as to their guaranteed nutrient percentages. Uniform methods are used to chemically determine

these nutrient guarantees.

There are 16 nutrients considered essential for plant life...12 of those often are provided in commercial fertilizers:

<u>Primary Nutrients</u>

Nitrogen

Phosphorus (Phosphate -- P_2O_5)

Potassium (Potash -- K_2O)

<u>Secondary Nutrients</u>

Calcium

Magnesium

Sulfur

<u>Micronutrients</u>

Boron

Copper

Iron

Manganese

Molybdenum

Zinc

Carbon, hydrogen, and oxygen are provided through air and water; the remaining nutrient, chlorine, rarely is lacking in our soils.

The Organic Mystique

It has been popular in some circles to promote the use of so-called "organics" as healthier for the plant, resulting in more nutritious foods, and other catch phrases. The facts should be examined carefully before accepting such suggestions because despite efforts to promote "organic" farming as most

healthful to the plant, or to those who eat plants, the plant does not differentiate. All the 12 nutrients which man applies to soils for crop use enter the plants as <u>inorganic</u> ions, regardless of whether the application is manure, legumes, plant residues, or commercial fertilizers. And, with the exception of some use of foliage applications, the nutrients mentioned previously enter plant roots via the soil solution. In other words, organic nutrient forms must first be converted to inorganic ions in the soil to be of use to the growing plant. Commercial fertilizers are nutrient materials designed to maximize plant nutrient uptake in the most efficient manner by providing those nutrients in forms readily available to plants.

Even though these facts have been known for more than a century, the misconception is still nurtured that use of "organics" -- animal manures, sewage, compost, plant residues, and such -- produce more nutritious foods, more productive soils, and, really, embrace the "natural" way to farm. These, Mr. Chairman, are false concepts. Again, plant nutrients enter plants as inorganic ions, going through the soil solution to the root surface and then through cell walls and membranes into the root.

Thus, references to sources of nutrients as "chemical," "synthetic" or as "organic," are often misleading. All substances, even water, are chemical; there are no exceptions. And the distinction of organic vs. inorganic often is an inaccurate reference to fertilizers. For instance, urea is an organic compound and is a major, high analysis nitrogen fertilizer, containing 45 percent nitrogen.

In the past several years, commercial fertilizers have provided about 20 million nutrient tons of nitrogen, phosphate and potash for crop production in the U.S. annually.

Use of these commercial fertilizers account for 30 to 40 percent of our current crop production.

According to a report by the Council for Agricultural Science and Technology (CAST, October 1980) there is approximately 50 million tons (dry weight) of animal manure, available for farm use, produced in the U.S. annually. The potential nutrient value of this 50 million tons, if produced in confinement, well-protected from weather and available in locations convenient to apply to cropland, is equivalent to the following fractions of nutrients applied in commercial fertilizers: 1/12 of the amount of nitrogen fertilizers now applied to the nation's cropland; 1/5 the amount of phosphate fertilizers; 1/5 the amount of nutrient in commercial potash fertilizers.

Thus, to provide nutrients for agriculture in the U.S. through animal manures as a replacement of commercial fertilizers would require increasing the number of animals on our farms by a factor of 5 to 12. Such an option clearly is not realistic, unless we can develop some "magic" feed for the animals themselves, and additional acres on which to grow that feed, as well as develop a booming world market for the resultant increase in U.S. beef, pork and milk.

Other facts regarding animal wastes are worth mentioning. It takes one ton of cow manure -- well-protected from weather elements -- to equal the nitrogen, phosphate and potash contained in only 100 pounds of a 10-5-10 commercial fertilizer -- a commercial fertilizer which, today, is considered low analysis and one rarely used on major crops. To apply 200 lbs. of nitrogen per acre, a rather typical application rate for commercial corn production today, approximately 20 tons of animal manure per acre would be needed assuming that it was applied under ideal conditions and there was no volatilization loss -- or escape of nitrogen into the atmosphere. However,

under usual farm conditions, significant nitrogen volatilization loss is likely from such applications. Thus, a more realistic estimate is that as much as 40 tons manure per acre would be needed to provide the 200 lbs. nitrogen.

Such facts clearly show that there is not enough animal manure, nor could we generate enough, to sustain levels of crop production necessary for our nation's well being.

Response to FINDINGS Under the Bill

Mr. Chairman, this bill is prefaced with several "findings" which are intended as justification for the legislation. We would like to comment on each "finding." We are in total agreement with Section 2, number one, which emphasizes need for highly productive agricultural systems. The U.S. now has the most productive, efficient large scale agriculture in the world, a direct legacy of extensive agricultural research and extension efforts, knowledgeable and efficient farmers, and production inputs, such as commercial fertilizers, which have provided economic substitutes for both land and labor.

Soil and water conservation is a concern and one to which government time and monies should be addressed...but not, we would submit, for such research as proposed in S.1128. Instead, where research is needed, we would endorse research which would not "fog" results with extraneous variables such as those which will exist under the proposal for "paired" farms. We would suggest research based on variables which could be documented and assessed accurately, with sound cause and effect relationships established. We would suggest that, instead of research monies for proposals in S.1128, funds for increased education and farmer incentives to accelerate use of proved conservation practices should be stressed.

Farmers are moving in the direction of minimum tillage -- both for economic and conservation reasons. But, do we need added research to prove that plowed-under legumes and crop residues benefit the soil? Or test plots to show the conservation worth of buffer strips, contour farming and similar practices? No. The evidence is there; the research has been done. The practices are valuable when incorporated with adequate plant nutrients to foster high productivity and ground cover.

Mr. Chairman, Finding number two relates to the contribution of current research efforts of the USDA and the various colleges and universities and the fact that they have a contigent role to play in fostering a more efficient agricultural production system.

The Fertilizer Institute would agree with this Finding. Indeed, we would salute the various research efforts that have contributed mightily to agricultural productivity. Our industry has been dedicated to the most efficient use of fertilizer materials, and the various research efforts of this country have assisted in that goal.

However, Finding number two would appear to contradict much of the remainder of S.1128. The finding praises current and past research efforts while the rest of this legislation would restrict and tightly direct this country's research efforts to the area of organic farming. It is interesting to note that this bill authorizes $10.5 million for organic research while the Agricultural Research Service of the USDA estimates, in earlier House testimony, that it has already spent approximately $18.8 million on research in this and related areas in 1983 alone. Thus, it appears that S.1128 calls for a duplication of effort.

Mr. Chairman, TFI would submit that we in this country have sought to avoid duplication of effort in government spending. We surely should not, intentionally, participate in such duplication.

With the federal budget deficit where it is today, we doubt seriously if the federal government can afford the appropriations called for in S.1128. And we feel that if the measure is pushed through into law the requested funds would necessarily be cut from other ongoing research efforts.

Mr. Chairman, agricultural research is an area where the USDA consistently has tried to improve performance even during current budget restrictions. It would be a shame for S.1128 to authorize millions of dollars to contradict that effort where prospects for concrete results are dim and prospects for duplication of known findings are so great.

Finding number three states an evident, and disturbing fact. Without repeating points made earlier, let me say that this bill would not appreciably add to the solution of soil loss problems. Again, we already know how to protect our soils. Many farmers practice soil-saving farming methods. The need here is not for added research, but farmer incentives and further education to promote the use of facts and methods already available on soil and water conservation.

Addressing Finding number four, the statement is made that agricultural practices are "needlessly dependent on limited global reserves of oil and natural gas." Aside from the fact that such a statement could be made about most segments of our society, depending on one's definition of "need," the presumption in this finding is that a viable alternative exists that would ensure a continued abundant supply of food at a lower

level of energy consumption. No such dramatic alternative has been made evident to the American people -- and I would dare say that every farmer considers his operation an energy-intensive business.

Insofar as the fertilizer industry is concerned, our production processes do require substantial amounts of energy. Yet, we have moved in a responsible manner to cut that consumption level -- and still produce more plant nutrients, more efficiently. Compared with the Department of Energy's base year for such figures -- 1972 -- our industry, in 1983, posted a 39-percent improvement in energy use efficiency in fertilizer production. This means that our industry's use of energy has declined by 39 percent for each ton of production since 1972. This measure of performance hardly signals an increasing energy dependence -- or, as the "findings" state, a heightened economic vulnerability.

In the area of public funding, outlined in Finding five, the bill calls a properly planned and balanced agricultural research program essential to improving agricultural productivity and conservation practices. I would maintain that public funding of agricultural research has been a major contributor to the advances in agriculture -- and that current research funding is more than adequate to fulfill the desires of this legislation, as noted in USDA's earlier testimony on the companion bill in the House.

Our public research framework has served our nation well. We see no merit or value in establishing parallel, duplicative, costly, and questionable research projects -- such as the paired farms proposal in this bill -- when the need has not been demonstrated.

Finding number six presumes two things: (1) that existing

research and extension efforts are not addressing the areas of improved agricultural productivity and conservation practices; and (2) that passage of this legislation will address those concerns. We feel that evidence for either assumption is widely lacking in testimony or backgrounding for this bill.

American agricultural productivity is the envy of the world -- and no alternate system has even approached this stunning level of modern agricultural achievement.

Additionally, allow me to comment that the attempt to wrap this organic research bill in the cloak of soil and water conservation is inappropriate and misleading -- since it promises something which, in our opinion, it cannot deliver.

I must repeat that the basic thrust of this bill presumes that:

1) current agricultural productivity is insufficient;
2) current agricultural systems cannot endure and remain profitable over the long term;
3) current agricultural practices are wasteful of natural resources;
4) current agricultural research is inadequate to address these concerns; and
5) new funding of alternative farming methods will produce responses to these concerns.

These are the premises and inferences which we cannot support. On each point, we urge extreme examination in justifying legislation.

Information Study

However, we do see value in the charge to the Secretary of

Agriculture, contained in Section 4 of the proposal, to conduct a thorough information study and we support such an effort. There is a great deal of existing, and related research underway, on practices involving conservation, energy use, cropping productivity, use of manures and crop residues, and small farm economic profitability. A special effort to consolidate, analyze and evaluate that research would be valuable. Thus, we would support necessary funding for such an effort, so that decisions on further research needs -- or research implementation -- could be made on a well-studied, intelligent basis.

Thank you, Mr. Chairman.

STATEMENT OF DR. I. GARTH YOUNGBERG, EXECUTIVE DIRECTOR,
INSTITUTE FOR ALTERNATIVE AGRICULTURE, INC., GREENBELT, MD

Mr. Chairman; Members of the Subcommittee:

I am Garth Youngberg, Executive Director of the Institute for Alternative Agriculture, Inc., a private, non-profit agricultural research and education Institute with offices in Greenbelt, Maryland. The Institute, which is governed by an 11-member grass-roots Board of Directors, seeks to advance, through the development of research and education programs, systems of food and fiber production that are economically profitable, resource conserving, environmentally sound, and sustainable in the long term. The Institute is grateful to the Subcommittee for the opportunity to testify on the Agricultural Productivity Act of 1983.

Because the general intent of S. 1128 is to develop sound educational and research programs in the area of alternative low-chemical agriculture*, the Institute is supportive of this proposed legislation. We believe it addresses a number of important needs and concerns which I will discuss briefly.

(1) Misinformation and Negative Symbolism - Alternative farming systems continue to be overlooked by most conventional agriculturalists, in part, because of the lack of credible information or misinformation on these farming systems. Many conventional agricultural scientists and farmers continue to believe that only "hippies," health food faddists, and displaced urbanites practice alternative agriculture. Moreover, these well-meaning but misguided individuals often are viewed as practicing their primitive, labor-intensive, agricultural crafts on small plots and with minimal success.

We believe that scientifically credible educational and research programs provide one of the most important vehicles for correcting these kinds of unfortunate and misleading stereotypes. In this regard, it is important that at least some of these research and education programs be conducted by so-called establishment scientists and institutions. Clearly, most conventional farmers continue to be heavily influenced by the research and education agendas of the USDA, the land-grant colleges and universities, and the educational and extension services associated with these institutions. To its

*Throughout this statement, the words alternative, biological, and organic will be used interchangeably to refer to those low-energy, resource conserving, environmentally sound and sustainable systems of farming which were defined in the 1980 USDA Report and Recommendations on Organic Farming. According to that Report: "Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests." We are attracted to this definition, in part, because of its emphasis on the total farm operation as an integrated, interactive system.

credit, S. 1128 would make it possible for some of these institutions to be involved in the development of modest programs of research and education on biological farming systems. Such involvement would likely have at least three positive effects. First, those scientists and educators who would participate in these researches would develop a more thorough understanding of, and appreciation for, the potential of alternative farming systems. Second, it would be reassuring to those conventional farmers who may be searching for these kinds of technologies to know that their local universities and extension services were involved in alternative agricultural research and education activities. Finally, these kinds of activities would help to begin correcting the erroneous perceptions of alternative agriculture currently held by many agricultural scientists, conventional farmers, and consumers.

(2) Informational Needs - Increasingly, biological farmers who may simply wish to improve their production systems, and conventional farmers who are interested in developing alternative farming systems, are beginning to seek-out reliable information on biological farming. For example, a large proportion of the attendees at the highly successful alternative agriculture field day now held annually at the University of Nebraska are conventional farmers. These farmers are interested in learning how legume-based crop rotations, green manure crops, improved manure and crop residue management, recycling technologies, and more diversified farming systems might help to reduce the rising costs of production and control soil erosion and the pollution of underground water supplies caused in part by excessive fertilization, pesticide use, and monocultural cropping systems.

In the short time that the Institute has been in operation, we have received scores of inquiries about these same kinds of technologies and concerns. Farmers are particularly interested in the economic benefits and costs associated with alternative agricultural production technologies. Paraphrasing for a moment, the following examples are illustrative of the kinds of questions we receive:

- Can I make money farming with alternative methods?
- How can I control weeds without herbicides?
- How can I control insects and diseases without pesticides and fungicides?
- If I want so shift to organic methods, what do I do first--how fast can I move?
- If I switch, are there markets for these products?
- Will I have special equipment needs? Tillage? Residue management?
- Are "alternative" products any good? Which ones? How can I be sure?
- What "alternative" crops (e.g.--peas, beans, etc.) can I grow in this area for increased N-fixation?

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- What are the best cover and green manure crops for my area? Where do these crops fit into the rotation and how long should they be allowed to grow for maximum benefit?

- What is the best way to handle manure--should I compost? Why?

- Must I have animal units to farm organically?

- What would be the best crop rotation for this area?

- What are the best seed varieties for my area?

- Is no-till possible without the heavy use of pesticides?

While a substantial amount of relevant information in these areas does exist, it is scattered and incomplete. Much of it also may be dated due to various technological advances. In any case, farmers complain that they are unable to get answers to these and similar questions from their local universities and extension services. I have heard of these difficulties repeatedly and often over the past several years in telephone conversations, personal correspondence, and during attendance at scores of meetings. In this regard, it is important for the Committee to realize that a growing cross-section of American society, including the urban sector, is increasingly interested in these low-chemical systems of farming. For example, a recent survey of consumer trends by the Food Marketing Institute found that more than three out of four Americans consider pesticide residues in their food a "serious hazard." Section 4 of this proposed legislation directly addresses the growing need to make this information available.

(3) Research Opportunities and Needs - Over the past several years, it has become increasingly clear that a growing number of agricultural scientists are motivated to conduct research on alternative farming systems. The following selected review of several recent scientific events and activities illustrates and underscores this trend:

- The 1981 Annual Meeting of the American Society of Agronomy sponsored and organized a full day symposium entitled "Organic Farming: Current Technology and Its Role in a Sustainable Agriculture." The Society has recently published the proceedings of this Symposium which includes fourteen research papers and reviews.

- Within the past two years, scientists at Iowa State University have hosted and organized two important conferences related to alternative agriculture. The following proceedings were published as a result of these conferences:

  - "Midwest Agricultural Interfaces with Fish and Wildlife Resources Workshop" - June 1-2, 1982.

  - "Management Alternatives for Biological Farming Workshop" - February 1, 1983.

- At the 1982 biennial research conference of the International Federation of Organic Agriculture Movements (IFOAM),

some 40 research papers on alternative agriculture were delivered. Approximately 15 of these papers were prepared by USDA and land-grant university scientists. Selected papers from this Conference are now available in Environmentally Sound Agriculture.

- In March 1983, the Swedish Agricultural University was co-host for a 3-day international symposium held to develop a research and education plan on alternative agriculture for the Nordic countries (Sweden, Norway, Denmark, and Finland).

- During the fall term, 1983, North Carolina State University began offering a regular, credit course entitled, "Alternative Agricultural Systems."

- One of the major topics last year at Virginia Polytechnic University's annual policy conference was alternative agriculture.

- During winter quarter, 1982-83, the University of Minnesota offered, on a trial basis, a credit course entitled, "Organic Farming."

- The recently published Agricultural Research Service Program Plan called for the development of "Alternative Agricultural Systems, Including Those of Small Scale, That Are Less Dependent Upon Nonrenewable Resources and That Are Productive, Efficient, and Sustainable in the Long Term." The plan went on to explain that "small farmers" and "organic farmers" "have some needs that are recognized but not met through current research programs."

- The University of Nebraska's Institute of Agricultural and Natural Resources has outlined its view of needed alternative agricultural research and education priorities in its 1983 Alternative Farming Task Force Report.

- This Spring, the Agricultural Research Service placed a research scientist at the Rodale Research Center, Kutztown, Pennsylvania. This scientist will study cropping systems that rely in varying degrees on organic and inorganic fertilizers, crop rotations, and aspects of biological pest control.

- I have just returned from a 3-day symposium held at Michigan State University entitled "Sustainable Agriculture and Integrated Farming Systems."

- The Institute for Alternative Agriculture is planning to begin publishing, in mid-1985, a professional, refereed journal devoted to alternative agricultural approaches. Roughly 25 of this Nation's leading agricultural scientists will comprise the journal's Editorial Board.

Clearly, there is no dearth of scientific interest in alternative agriculture. Indeed, the opportunity for assembling top scientists to conduct the research envisaged in this legislation is excellent. In this regard, S. 1128 could provide an important catalyst for the development of interdisciplinary, systems-oriented research on biological agriculture.

The need for conducting research and education programs in the area of alternative agriculture has been documented in a number of scientific studies and reports. For example:

- U.S. Department of Agriculture, 1980. Report and Recommendations on Organic Farming. U.S. Government Printing Office, Washington, D.C.

- Elm Farm Research Centre and International Federation of Organic Agriculture Movements, 1983. Research Projects in Biological Agriculture in Western Europe and the United States, Elm Farm Research Centre, Report No. 2, Great Britain.

- American Society of Agronomy, 1984. Organic Farming: Current Technology and its Role in a Sustainable Agriculture. ASA Special Publication Number 46, Madison, Wisconsin.

In varying degrees, these and other studies and reports have emphasized the need to:

(1) review and make available scientific literature of relevance to biological agriculture;

(2) survey and document successful biological farms;

(3) conduct comparative studies of conventional and biological farms; and

(4) carry out research on the conversion of conventional farms to biological systems of production.

S. 1128 directly addresses these scientifically documented needs.

At least two additional positive aspects of S. 1128 deserve special comment. First, this legislation correctly provides for both public and private institutional involvement in the conduct of the prescribed research (Section 8). We believe that the part cipat on of a variety of both public and private agricultura research and education institutions will contribute to the need for perspective, objectivity, and legitimacy during the execution and reporting of the proposed research. Second, the nterdisciplinary aspects of the information study (Section 4) and the pi ot research projects (Section 5) are also appropriate and necessary Given the agronomic, economic, social and policy complexities of alternat ve agriculture, a broad range of disciplines, working together, affords the best hope for understanding and improving biological farming systems.

In closing, Mr. Chairman, we would urge you to push for the adoption of S 1128. This bill could help our Nation's farmers begin to wean themse ves away from their heavy dependence upon increasingly expensive fossil fuel-based production inputs. In this sense, this legislation directly addresses many of the needs of a broad section of American agriculture: lower operating costs, resource conservation, environmental protection, and long-term sustainable food production. We urge the Subcommittee to continue working for these goals.

Thank you.

[The following material was furnished by Dr. C.E. Howes of CAST:]

The Council for Agricultural Science and Technology: Some Field Notes and Recommendations for Action by the Rural Sociological Society

(By Frederick H. Buttel, Cornell University and Harry K. Schwarzweller, Michigan State University)

This report is based on the experiences of the two authors with the Council for Agricultural Science and Technology (CAST), an organization formed in 1972 to disseminate scientific information on issues relating to agriculture. Both were participants in a recent CAST task force on "organic farming and gardening," and the second author has been closely involved in CAST affairs in the capacity of President of the Rural Sociological Society. We feel that these experiences are of sufficient importance to warrant a special effort to communicate them to the RSS membership. This is particularly appropriate in light of the fact that CAST affiliation recently has been a controversial issue among RSS officers and the general membership of RSS.

The present report will not reduce the level of controversy surrounding CAST. Indeed we will conclude this paper with a set of recommendations suggesting that continued RSS affiliation with CAST should be contingent upon the invocation of significant reforms by the CAST organization. We will also not limit our comments to our own personal experiences with CAST. We feel that it is important to include additional information about the structure and functioning of CAST which has appeared in recent newspaper and other accounts.

A task force that was nearly not meant to be (for RSS)

During the February 1978 annual meeting of the CAST Board of Directors, it was decided that there should be a task force on the topic of "organic farming and gardening," along with task forces on three other topics. During spring and summer, CAST, under the leadership of its Executive Director, Dr. Charles Black, Iowa State University agronomist, began to formulate the membership for and the statement of the mission to be accomplished by this task force. The basic mechanism for delineating the membership of a task force is for the Executive Director to contact the CAST representatives of the member scientific organizations which the Executive Director feels may have expertise that can contribute to the writing of a task force report. It also appears that the Executive Director or the Chairperson of the given task force may select other persons who are not specifically nominated by the CAST representatives of the scientific societies.

The membership of the task force on organic farming and gardening was preliminarily set during August of 1978. Once again, there was no RSS member on this task force. It has often been an issue of contention among RSS members that our organization is frequently by-passed in the selection of task force members. Somewhat irritated, Schwarzweller, in the capacity of RSS President, wrote a strongly worded letter to Dr. Black inquiring as to why RSS was again by-passed when: (1) organic farming is clearly a *socioeconomic* as well as technical issue, and (2) there are a number of RSS members who have done, or are in the process of completing, research on organic farming or the alternative agriculture movement.

This letter prompted a somewhat apologetic reaction from Black, and RSS was invited to send two members to participate on the task force. After consultation with William Heffernan of the University of Missouri (recently appointed RSS representative on the CAST board), it was decided that Buttel and Schwarzweller would be these two representatives.

After accepting these responsibilities, Schwarzweller received a letter from Black responding to Schwarzweller's inquiries about the functioning and philosophy of CAST. Black recognized that rural sociologists may, at least in part, perceive of CAST as a sociological phenomenon. He proceeded to provide his own sociological interpretation of CAST, and some of these passages are worth quoting. He wished to make it clear that the principal rationale for the formation and operation of CAST was to correct misinformation about scientific issues relating to agriculture. Black stated that: CAST was formed as a consequence of what members of the scientific community in the area of food and agriculture perceived as inadequate understanding and use by the government and the public of scientific knowledge in their area—knowledge that has been painstakingly accumulated over many years. The sociological phenomenon that brought to a head this feeling on the part of scientists *was the environmental movement*. As a result of another sociological phenomenon,

namely, the willing and eager cooperation of the news media in *propagating environmental propaganda* (sic), the environmentalists were making great strides in convincing the public of the validity of their views, which generally contained at least a grain of truth but were known by scientists knowledgeable about individual subjects to be unsound in some respects (emphasis ours).

In this letter, Black then asks rhetorically—with the formation of CAST as the understood answer—the following question: In the face of the unwillingness of the news media to listen to reason and to convey factual information to the public about environmental matters, what could be done by members of the scientific community to improve the situation?

These passages should be sufficiently clear to indicate that CAST—or at least the present leadership of the organization—is largely committed to staging a struggle with environmentalists and the media. We do not wish to deny that environmental rhetoric is sometimes overstated. And errors of fact do indeed appear in the American press. However, these views of the Executive Director of CAST (who is paid a tidy sum of $41,000 per year by Iowa State University to perform his CAST functions) appear to us to be an overreaction.[1]

Our next communication from Dr. Black was his September 20, 1978, memo to participants on the organic gardening and farming task force. This memo contained a list of "responsibilities" for task force members. In prefacing the specification of these responsibilities, Black had the following words to say about the subject matter: As you know, "organic" farming and gardening and "organic" food are counter-culture issues of continuing concern. We cannot expect that the supporting cults will disappear on publication of your work on the subject, but the credibility of CAST as a scientific organization should help both the faddists and non-faddists to appreciate what it is all about.

Two observations are of particular interest with respect to the preceding quote. Firstly, Black essentially equated organic farming and gardening as being trivial pursuits, i.e., fads and cults. Secondly, Black presumed implicitly that the task force report would not come out in favor of organic farming and gardening—hence the supposition that the "supporting cults" will not disappear despite this forthcoming report. The memo from Black can essentially be interpreted as trying to set a negative tone for the entire task force by its implicit belittling of the notion of organic farming and gardening.

Our next communication from CAST personnel was a memo from Samuel R. Aldrich, University of Illinois agronomist and Assistant Director of the Illinois Agricultural Experiment Station.[2] Aldrich had been selected as Chair of the organic farming and gardening task force and sent this memo to task force members on October 10, 1978, to set forth plans and procedure for the meeting of the task force in St. Louis, October 18–20. Aldrich repeated much of the material from Black's memo of September 20, and added some additional material that is also of interest. Aldrich, in the quote that follows, echoes many of the assumptions of the Executive Director: Organic farming proponents can influence financial support for research and legislation and administrative agency rulings relating to pesticide registration and use, future priority of fossil fuels for fertilizer and pesticide manufacture, land use and cropping systems in the Section 208 U.S. Environmental Protection Agency program, and feed additives and antibiotics for livestock . . . . Media attention to organic farming and gardening has mushroomed in the past two years. Their sources of information have been mainly technically untrained persons who were eager to find substitutes for modern high-technology agriculture.

One month later, we were off to St. Louis.

On beating one's head against the wall: Confrontation at St. Louis

We arrived in St. Louis the afternoon of October 18 and prepared to make the best of three days in a largely rundown Holiday Inn near the St. Louis airport. The task force began that night with dinner and a preparatory discussion. It was not clear whether the discussion was planned by the task force chair. To us, the prompting for this discussion was by an agronomist from the University of Nebraska, Dr. T.M. McCalla. McCalla, somewhat surprisingly (perhaps to Dr. Aldrich as well!), had had major contact with organic farming proponents and significant experience on research related to organic farming. McCalla had been a student of William Al-

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[1] The salary figure is as reported in Tom Knudson, "Thousands of State Dollars Back Group." *Des Moines Sunday Register* (21 January 1979), 1F–2F.

[2] After accepting the assignment on the task force, it came to our attention that Dr. Aldrich had previously been an extremely vocal opponent of organic farming—hardly the objective researcher required to head up a task force on such a sensitive area.

brecht, deceased University of Missouri agronomist who for many years was essentially the only U.S. agricultural scientist sympathetic to organic farming. At the opening night dinner, McCalla sensed that virtually all persons at the task force meeting were clearly hostile toward organic farming. McCalla thus asked each person present to state their views on the issue. We were somewhat shocked at the generally vocal, defensive, negative views expressed by roughly 75 percent of the task force membership. Most of the agricultural scientists present seemed convinced that organic farming and gardening were some sort of conspiracy being directed at the very survival of the U.S. as an advanced industrial society. We were both quite vague on our views and opinions at this juncture, preferring instead to get a sense of the feelings of the other participants. Four beers later, after much head-shaking and soul-searching, we were back to our rooms in preparation for the events of the next two days.

The first full day of the task force meeting was the most important. Early in the morning there was a brief continuation of the dialogue of the night before. We began our first probes of the intentions of the task force participants at this point. Schwarzweller made the point that the mission of the task force would be better conceived if directed at specifying which aspects of organic farming would be useful for which farmers, under what conditions, and with what probability of success, and on the other hand, which other aspects of organic farming were not so useful or scientifically sound. Buttel argued that the organic farming movement was not so consensual and monolithic as it appeared to the agricultural scientists assembled at St. Louis. He pointed out that, for all practical purposes, the movement was severely divided as to the proper scope of organic methods (i.e., should all farmers come to adopt the small-scale "purity" of the Robert Rodale approach, or should the application of organic methods stress how the small- or moderate-scale commercial farmer could use such methods?)[3] Both sets of comments were virtually ignored, and business as usual proceeded.

During the early afternoon of October 19, we were divided into several work groups which would have principal responsibility for one particular section of the report. We were included in a group which had the broad charge of investigating the effects of organic farming on land use, erosion, and "socioeconomic conditions."

The one-sided battle we lost during the morning set the stage for our presumed role in the report. Our charge was to specify what would be the effects of a 100 percent changeover from conventional farming methods to organic methods. To us, this simply was not an important issue. First of all, such a change is inconceivable at this point—despite the general paranoia that prevails about EPA, FDA, and the like. Secondly, a 100 percent changeover to organic farming raises important definitional problems that we felt could not be adequately dealt with. What would such a changeover entail? Aldrich et al. wished for us to assume that this changeover amounted to cessation of use of fertilizers, pesticides, and antibiotics. Not all organic proponents suggest that all fertilizers, pesticides, and antibiotics be banned. For instance, one of the key persons associated with the "organic" movement, the recently deceased Robert van den Bosch (formerly of the University of California-Berkeley) has been a prime mover in encouraging "integrated pest management" (IPM). IPM of course entails reducing—but not necessarily eliminating—pesticide use.[4] Essentially we were being forced to evaluate an "organic" system that not all organic farming proponents endorse. Before breaking for our smaller working groups, we were given an additional bit of information that made our task even more irritating. Robert C. Oelhaf, the one U.S. economist who has probably done the most research on organic farming, had requested of Black and Aldrich that he join the task force to give his views. Oelhaf is the author of the only existing book-length treatment of organic farming from an economic perspective[5] and would have been a valuable

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[3] The political scientist Garth Youngberg has conducted extensive research on the "alternative agricultural movement" (which is closely akin to "organic farming and gardening") and argues that: (1) the movement is extremely diverse and to some extent fractionalized in terms of ideology, and (2) movement organizations are extremely diffuse and have had only minimal impacts on public policy. These observations are directly counter to the assumptions made by CAST personnel when formulating the task force on organic farming and gardening. See Youngberg, "The Alternative Agricultural Movement." *Policy Studies* 6 (Summer 1978), pp. 524–530.

[4] See, for example, Jerome Goldstein, *The Least is Best Pesticide Strategy* (Emmaus, Pennsylvania: JG Press, 1978). Goldstein is one of the most visible personalities in the "organic" movement, and his moderate approach regarding pesticides is contrary to the image of organic agriculture assumed by the chair of our task force.

[5] Oelhaf, *Organic Agriculture: Economic and Ecological Comparisons With Conventional Methods* (Montclair, New Jersey: Allanheld, Osmun, & Co., 1978).

task force participant whatever his views might be (which are clearly favorable toward organic farming). Aldrich informed the task force that he had rejected the request of Oelhaf to attend because it was apparent he was "biased." We wondered between ourselves how Aldrich could justify this decision while at the same time indicating to us that he was unbiased and objective.

The only economist in attendance at the task force and participating in our work group was a young agricultural economist from Texas A & M University. This person, while well-intentioned and competent, did not himself have sufficient total expertise to substitute for a person such as Oelhaf. The economist had himself done significant, competent research (using systems modeling methods) on the likely effects of 100 percent bans on fertilizers and pesticides—exactly the kind of information desired by Aldrich. But it does not take a sophisticated economic analysis to determine that if such bans were instituted with no significant structural change in agriculture (i.e., little movement toward crop rotations, localism in food production and marketing, additional research by *land grant universities* on organic methods and biological control of pests), the effects would be devastating (at least in the short-run).[6] The economist's analysis, however, became the focal point of our group report.

In the small work group milieu, Schwarzweller was given the responsibility of speculating on what the effects of a 100 percent movement toward organic farming would imply for the labor force. Buttel was directed to discuss other socioeconomic impacts and, at least at one point, how organic farming methods might be useful for certain groups of farmers such as small farmers. Between the two of us, we prepared roughly 10 typewritten pages of material, including references. As we will discuss below, when we received the draft of the task force report, only two sentences of our material (with some word changes from Schwarzweller's draft) were included.

The morning of the 20th, we again met as a full task force to discuss the progress we had made in preparing our group reports. At this point, Buttel began to object more vocally to the premises and organization of the task force. He again brought up the ambiguity of defining a 100 percent change from conventional to organic methods and again was ignored. The task force ended in early afternoon, and tired from three exhausting, frustrating days, we returned to our respective universities.

Before leaving the scene of the actual task force meeting, it is important to state that we (Buttel, Schwarzweller and McCalla) were not the only persons sympathetic to or open-minded about organic farming present at the task force. Two scientists from Pennsylvania State University and one from SEA-USDA expressed regret about the conduct of the task force to us privately. Why they did not object more loudly is unclear. Our sense is that they were well aware that they were in a minority and felt that any statements that they might make were going to be ignored—much like that which occurred to us.

After the fact and behind the scenes

Our next contact with the task force was our receipt of a memo from Samuel Aldrich dated November 9, 1978, which contained a copy of the draft report. We carefully read through the report, wondering where and in what form our material was presented. Again, all of Buttel's material was deleted, and two sentences of Schwarzweller's material were modified and inserted.

We realized that since virtually all of our material was omitted, the only way that we could evaluate the report (Aldrich did ask for comments) would be to have other agricultural scientists prepare written reviews. Buttel contacted several such scientists, asking for their critical comments on the first draft of the report. Buttel attempted to obtain a relatively diverse group of scientists for such a review. Included in this group were three members of the Wasington University's study team (which has done the most sophisticated and widely publicized study comparing organic and conventional farms); one member of the Cornell University entomology faculty who tends to be critical of prevailing agricultural practices (but who is himself somewhat skeptical regarding organic farming); a distinguished Cornell University professor of Vegetable Crops; a fellow rural sociologist at the University of Illinois; Robert Oelhaf; a Macdonald College/McGill University entomologist who is a strong advocate of organic farming; and the director of research at the Organic Gardening and Farming Research Center (which is a major, although not single, representative of the organic movement).

[6] Ironically, the work of the economist (which was included in the draft of the task force report) did demonstrate that total bans on fertilizers and pesticides would dramatically improve farmers' incomes, although such bans would increase food prices for consumers.

Not all persons supplied comments. The Cornell Vegetable Crops professor tired of the task because he found the report too scientifically inaccurate to warrant further attention. The Director of the organic farming research institution also failed to provide comments. Very thorough comments were received from the three Washington University researchers and the Cornell entomologist. These thorough, essentiially uniformly critical reviews were eventually forwarded to Aldrich and Black. Their comments, at this point, have not yet been received.

Buttel also contacted Loren Soth, a distinguished writer from the Des Moines Register, a Pulitzer prize winner, prolific author of books on agricultural policy, and recipient of the highest honor of the American Agricultural Economics Association (the "Fellow" award), regarding the events surrounding the CAST task force. Soth has written several major articles critical of the operation of CAST, and expressed the difficulties he has had in compiling information about the functioning of the CAST organization. Certain material provided to him by Buttel has been included in subsequent articles on CAST written by Soth.

While it is obviously impossible to summarize briefly the content of the draft report, we believe it is fair to say that the report has the strong impression of bias. We do not wish to quote extensively from the report because, in all fairness, it is yet a draft. However, one example may be useful to indicate how far the report goes to make the least supportive case possible for organic farming. On page 4 of the report, it is argued that the major kind of research that has been done thus far on organic farming (comparisons of paired organic and conventional farms) is "not a valid substitute for research data." This, not surprisingly, is the major form of research underatken by the Washington University team and by Oelhaf. Further, it is stated in the draft report that "we deplore the widespread distribution of unreliable and often misleading information," in reference to these on-farm, paired comparisons. We feel that it is important to mention that the research criticized by the report: (1) has been conducted by scientists with Ph.D. degrees from well-recognized universities (e.g., Harvard University, University of Maryland), and (2) tends to show that organic farming compares favorably with conventional agriculture in economic terms, while at the same time reducing energy use in agriculture by roughly one-half and reducing soil erosion.

After stating that such on-farm comparison studies be completely ignorod, an interesting non sequitur follows. On page 12 of the draft reports, the Washington University study is cited as apparently authoritative evidence that the effects of organic farming would be unfavorable for the labor force in agriculture, since organic farming (according to the Washington University study) requires 12–15 percent more labor than conventional agriculture, i.e., is "less labor efficient."

Such nonsense or appearance of apparent, contradictions in thought cannot be totally attributed to the fact that the task force chair is merely a nonsubstantive editor of the reports of other scientists who themselves might disagree on the validity of on-farm comparison studies. In point of fact, the task force chair has—in conjunction with Dr. Black—virtual autonomy over the content of the report. A recent controversy related to this structural feature of CAST will be discussed later. Nevertheless, the final report is largely the responsibility of the task force chair, and the role of the task force member apparently is primarily limited to recommending the type of information that should be included in the report. We have heard no further word on the status of the task force report or on the criticisms we (and cooperating scientists) have made.

Related developments

A January 23, 1979, article in the New York Times entitled "6 Scientists Quit Panel in Dispute Over Livestock Drugs" caught our eye just after we had submitted our comments to Aldrich and Black.[7] This article recounted the controversy that had emerged in another CAST task force on routine use of antibiotics in animal feed. The six scientists referred to in the title of this article had done research ostensibly documenting that routine use of antibiotics in animal feed causes the development of resistant strains of bacteria, and that the resistant bacteria in turn could produce diseases in humans that are difficult, if not impossible, to control with available drugs.

The six scientists charged that the chair of their task forced willfully changed the wording of their statements to imply that routine use of antibiotics "might" have such effects (when the six scientists appear to have evidence that such effects *do*

[7] Bayard Webster, "6 Scientists Quit Panel in Dispute Over Livestock Drugs," *New York Times* (23 January 1979), p. C2. A related article is George Anthan, "Scientists Resign in Protest of 'Bias'," *Des Moines Sunday Register* (21 January 1979), pp. 1F-2F.

occur). The antibiotics researchers claims that the substance of the draft report received from their task force chair "suggests that the wholesale use of antibiotic prophylactics is safe and beneficial, 'an implication that is contrary to fully accepted standard of medical practice'." [8] The six scientists, representing University of Wisconsin-Madison, University of Alabama, Duke University Medical School, and the Public Health Institute of the City of New York, have resigned from the task force. They have charged, in their memoranda, that the underlying purpose of the CAST task force on use of antibiotics in animal feed was to produce " 'a document that would be used to directly counter' a proposal by the Food and Drug Administration to ban the use of such antibiotics."[9]

Although there have not as yet been any resignations from our task force on organic farming and gardening, there are striking similarities between our experiences and those of the six antibiotics researches. Both task forces apparently were conceived to head off possible actions by the federal government that would affect U.S. agriculture. Both task forces were conducted in a milieu of defensiveness and overreaction, and both task forces exhibited the suppression of relevant evidence that disagrees with the kind of message CAST wished to convery to the public and government officials. We certainly do not disagree with the notion that an organization such as CAST should be responsive to fast-breaking developments in government policy and offer a reasoned perspective on the prospective changed policy. What we do find objectionable is the consistent record of defensiveness in the reports, the stacking of task forces with a majority of relatively conservative agricultural scientists, the consistent underrepresentation of the social sciences, and the apparent willingness to distort or misrepresent results to achieve the kind of statement that CAST desires.

We do not wish to leave the reader with the impression that all CAST task force reports are inaccurate or biased. The CAST report on soil erosion, for example, was a very high quality report which effectively argued that soil erosion is rampant, increasing in prevalence, and needs much more federal action. CAST has also completed useful reports on agriculture and energy and other topics. However, we believe that there is fragmentary, but emerging, evidence that when CAST tackles a very sensitive issue (i.e., an issue that might involve criticism of agribusiness, large-scale agriculture, etc.), CAST tends to make very attempt to produce a report that defends the present agricultural system.

We feel we lack sufficient information to indicate whether the controversies surrounding CAST derive primarily from its leadership or from the very structure of the organization. Most rural sociologists are doubtless aware of the fact that CAST receives heavy financial support from large agribusiness companies.[10] The major membership categories include these agribusiness firms; agricultural science organizations, including RSS; sustaining members; subscriber members; and individual memberships. Its membership reads increasingly like the same group as the ARI, Agricultural Research Institute, certainly a private sector dominated outfit, rather than simply a set of land grant scientists CAST was originally intended to be.) Can CAST significantly change under the direction of new leadership given the high dependence on agribusiness firms for financial support? We cannot answer these questions. Nevertheless, it would appear that CAST will acquire new leadership in the relatively near future, since Dr. Black is apparently in his late 60's. We urge that RSS continue to monitor the performance of CAST over the coming years under the perspective of whether or under what conditions RSS should continue its affiliation with CAST.

Why be Concerned about CAST?

We would not be surprised to learn that well over half of the RSS membership has neither seen at least one CAST task force report (out of the more than 70 already issued) nor seen an issue of *News From CAST*. This might lead many to believe that CAST is largely invisible and that it makes little sense to express so much concern about how CAST operates. We have also encountered a parallel argument

[8] The first portion of the quote is by Webster, op. cit., and the second portion is by Dr. Richard Novick, one of the scientists involved in the dispute with the CAST panel on antibiotics.

[9] The first portion of the quote is by Novick and the second Webster.

[10] The agribusiness firms are considered by CAST to be "supporting members." CAST currently has 97 such members, who contribute from $200 to $5,000 to CAST annually. Supporting members include: Agrico Chemical Company, American Cyanimid Company, BASF Wyandotte, Chevron Chemical Co., CIBA-GEIGY, Dow Chemical Co., E. I. du Pont de Nemours & Co., Eli Lilly and Co., Deere and Co., Massey-Ferguson, Inc., Mobil Chemical Co., Pfizer Animal Health [illegible] Shell Chemical Co., Stauffer Chemical Co., Tenneco Oil Co., Union Carbide, and [illegible] *[illegible]s From CAST* 5 (March 1978), pp. 19–20.

among many of the agronomists, horticulturalists, entomologists, and other agricultural scientists that we have been in contact with over the past few months: It is frequently argued that CAST is so inherently biased and so totally discredited in the eyes of many agricultural scientists that we should pass off its action with indifference and resignation.

Despite these arguments, we feel that it *is* important to be concerned about CAST. Firstly, CAST *is* influential among some public decision-makers—even if it is less so among agricultural scientists. Copies of each CAST report go to all Senators and Representatives in Washington, D.C., major USDA officials, relevant Presidential Cabinet members, and research and extension personnel in the state agricultural experiment stations. Further, CAST generally initiates its reports with a large news conference in Washington, D.C., with writers from major newspapers from around the country in attendance. Thus, the contents of CAST reports do get wide distribution among public policy-makers and, to a lesser extent, among the general public.

Secondly, we feel that CAST has become an integral contributor to, although by no means the exclusive vehicle of, an attitude of defensiveness on the part of the agricultural research establishment that is perceived by many members of Congress. It is indeed the case that the land grant college research complex is increasingly being judged as not sufficiently objective to carry out research on sensitive topics such as environmental/pesticide/toxic chemical issues. For example, regulation of pesticides has been shifted from USDA to EPA because of a feeling by Congress and members of the Executive Branch that USDA and land grant researchers have tended to lack the objectivity necessary to make these tough decisions. FDA likewise has slowly begun to take over some of the regulatory functions over which USDA once had jurisdiction. Finally, research funds that 10 years ago would have almost automatically gone to USDA and the land grant colleges are now being administered by other agencies such as EPA, HEW, and so forth, and this research in many cases is being completed by non-land grant personnel. If present trends continue, we foresee further diminution of the role of the land grant colleges—including rural sociology programs—in agricultural research and provision of policy recommendations to public decision-makers.

Further defensiveness—on the part of CAST, kindred organizations, and individual scientists—will not improve this situation. Indeed, we feel that such reactions will only make matters worse. Therefore we would argue that it is important to be concerned about CAST because our future as land grant college researchers is at stake. If public decision-makers (especially those with "environmentally-related" responsibilities) come to view CAST as representative of the posture of all land grant researchers, the role of the land grant college may indeed be in jeopardy.

For over three years, the RSS Council has wrestled with the recommendation of certain Council members and other members of the Society that RSS withdraw from CAST. We realize that much of the material we have presented in this report could be construed as patent evidence supporting such a measure. However, we do not recommend withdrawing from CAST at this point for two reasons: (1) in fairness, we believe it is desirable to insist on the four reforms to be specified below as minimal conditions of our further participation in CAST, hoping that we can help make CAST a more objective, open-minded organization. (2) We would argue that because of the influence that CAST has, plus the ways in which CAST may be contributing to an undesirable image of the land grant colleges, it is important to attempt to struggle to change the role that CAST presently occupies.

If RSS withdraws from CAST—even if such a withdrawal occurs with a high level of media attention and related publicity—we will perhaps be abdicating to unobjective agricultural scientists a role that is rightfully ours. In other words, we believe, at least for the present time, that it is in the interest of rural sociologists to fight for change in CAST rather than allowing business as usual to proceed unchallenged. We are not optimistic about the possibilities for change in CAST in the short-run, to be sure. But we feel that RSS, as a member organization of CAST which contributes over $400 per year to the operation of the organization, has a moral obligation to attempt to influence the land grant college complex and its related organizations (such as CAST) to take more responsible stances on research priorities and public issues.

Taking the bull by the horns: Some recommendations for action by RSS

We recommend, on the basis of our observations and experiences, that RSS continue to belong to CAST *if and only if* four major reforms are made in the structure and functioning of the CAST organization. All these reforms are geared to achieve a greater diversity of scientific opinion on each task force.

The first reform is one of opening up the membership of task forces to include: (1) more social scientists, and (2) more persons from outside the land grant university system, to participate on task forces. In addition member organizations would be asked to include the diversity criterion in their own selection process. Specifically, we recommend that our participation in CAST be conditional upon the Executive Director asking RSS for one or more members of *each* task force. We feel that our CAST representative knows better—certainly better than an agronomist—when the Rural Sociological Society possesses expertise relevant to a given task force. We of course need not send a representative to each and every task force. However, we should insist on being able to send a representative if we desire to do so. Further, we believe that there should be greater accommodation of persons who wish to join task forces (especially if they are not land grant personnel). We do not wish to imply that all persons be allowed to attend task force meetings and participate in the preparation of reports. However, we recommend that persons requesting to attend be voted on by the task force membership, and that a majority of votes by task force representatives be required for an "outsider" to attend and participate (up to a maximum of five additional persons—the five persons with the highest vote totals would be selected to attend if more than five received majority votes). We recommend that upcoming task forces be more visibly "advertised" in *News from Cast* (the CAST newsletter) so that more persons might hear about upcoming task forces. Interested persons would be expected to prepare a statement of their qualifications for a task force and the reasons why they wish to become a member of that particular task force; these would be distributed to task force members before their vote.

The second reform is that the chairperson of each task force be elected democratically by the membership of the task force. Although the member organizations can send members to each task force, the role of chair is critical. Hence, to elect a chairperson democratically would involve task force members volunteering to serve as task force chair, and having members vote on those candidates until one person has a majority of votes. Even if the procedure is somewhat cumbersome, it would prevent "engineering" the results of a given task force by the CAST leadership.

The third reform would be that there should be an opportunity to prepare (an unedited) minority report if three or more persons on the task force request one. At the present time, no such opportunity is available to task force participants, to the best of our knowledge. The opportunity for minority report, we might add, is standard practice among the most prestigious of scientific organizations such as the National Academy of Sciences when comparable projects are undertaken.

A final reform required, in our view, is that the task force have sole autonomy in preparing the main report (and the minority report, if the members choose to prepare one). This is because we have learned that the Executive Director of CAST often edits reports in substantive ways (and may even commission a new task force if he disagrees with the results of the initial task force report). We recommend that RSS participation in CAST be contingent upon total and complete autonomy of the task force membership over the content of the reports made.

We also tend to favor a fifth prospective reform in CAST—prohibiting acceptance of or at least reducing dependence on funds from agribusiness corporations. We do not choose to make a formal recommendation of this reform at this time because it would necessarily lead to a virtual undermining of the financial basis of the organization. (Roughly two-thirds of CAST's support derives from contributions from agribusiness firms.)[11] We do not feel that an organization that purports to be objective and scientific should accept funds from partisans from any side in scientific debates. It is frequently the case that the financial interests of agribusiness—e.g., a continuing favorable climate for the sales of manufactured fertilizers, pesticides, antibiotics, large-scale machinery, and the like—are usually intimately related to the subjects of major task force reports (especially the most controversial ones). We suggest that the CAST leadership take immediate steps to reduce the dependence of CAST on agribusiness funding. Possible strategies for CAST to reduce dependence on corporate funds would be to attract (non-agribusiness) foundation or government grants or to substantially reduce costs by substituting, where possible, telecommunications technology for high travel costs to task force meeting sites. We also urge the RSS council and the RSS CAST representative to argue for reduced dependency on agribusiness corporation funding on the part of CAST.

[11] Knudson, *op. cit.*, p. 1F.

CONCLUSION

The purpose of the present paper is to provide an analysis of the operation of the Council for Agricultural Science and Technology based on our observations and experiences and make recommendations for action by the Rural Sociological Society. Our feeling is that the present operating procedures of CAST tend to inhibit the production of unbiased reports and are progressively undermining the credibility of the land grant colleges. We feel that RSS should attempt to foster change in the functioning of CAST. Specifically, we recommend to the RSS Council that our participation and membership in CAST be contingent upon the invocation of four reforms—and possibly a fifth—in the procedures for generating CAST reports. These reforms include the opening up of membership in task forces to include more social scientists and non-land grant personnel, the democratic election of CAST task force chairpersons by the membership of each task force, the opportunity for preparation of unedited minority reports, and the complete autonomy of task force members in preparation of reports. We feel that CAST should be given sufficient time to consider these reforms, i.e., be given two annual meetings over which to consider our recommendations. If, after two annual meetings, all four conditions have not been met in their entirety, we feel that RSS should then withdraw from membership in CAST.[12]

We mentioned a fifth prospective reform concerning taking steps to eliminate agribusiness corporation funding of CAST operations. We recognize that several years would be required before such a reform could be implemented because of the presently heavy dependence of CAST on corporation agribusiness funders. Nevertheless, we feel that this is a crucial issue and recommend that future RSS Councils monitor the progress that CAST is making in freeing itself from financial dependence on partisans in many of the scientific debates in agriculture.[13]

[12] It should also be noted that the kinds of reforms that we recommend RSS insist upon would logically have the effect of eliminating the presence of agribusiness corporation representatives from the CAST Board of Directors. Since CAST would no longer be accepting donations from agribusiness corporations, these corporations would have no justification for representation on the CAST Board. However, if agribusiness representatives do continue to serve on the CAST Board, we feel that RSS should favor comparable representation by staff members of consumer, land reform, and even organic farming groups on this Board.

[13] The reader may also wish to consult Robin Marantz Henig, "Agriculture's Strange Bedfellows: CAST-Industry Tie Raises Credibility Problems," *Bio-Science* 29 (January 1979), pp. 9–12, 59. We wish to thank Paul R. Eberts, Department of Rural Sociology, Cornell University, for helpful comments on an earlier draft.

ISSN 0194-4088

ORGANIC AND CONVENTIONAL FARMING COMPARED

Council for
Agricultural Science and Technology
Report No. 84
October 1980

FOREWORD

Organic farming and gardening are subjects that generate much emotion among so members of the general public, recurring coverage by the media and occasional attention by members of the Congress. Because the scientific information required to place the issues in perspective is little appreciated and generally overlooked, the CAST Board of Directors authorized the development of a report to provide the needed background. The multidisciplinary task force of scientists assembled to address the issues met in St. Louis, October 18 to 20, 1978, to prepare a first draft. The first draft gave only minor emphasis to organic gardening as such, and this approach has been carried through to the final publication. The scientific principles discussed in connection ith organic farming apply equally to organic gardening, however, and so organic gardening, is by no means overlooked.

The task force included 24 scientists with collective expertise in agricultural economics, agricultural engineering, agronomy, animal science, dairy science, entomology, food science horticulture, nematology, plant pathology, poultry science rural sociology, soil science, soil testing and plant analysis, veterinary medicine, veterinary toxicology, and weed science.

Several successive drafts of the report were prepared by the chairman and were returned to members of the task force for review and comment. The report was then edited by Jon A. Smith, with assistance from the CAST staff, and additional drafts were returned to task force members for review and comment before the final draft was reproduced for publication.

On behal of CAST thank members of the task force and al the others who gave of their time and talents to prepare, review, and comment on this report as contribution of the scientific community to publi understanding. Thanks are due also to the employers of task force members who made the time of their employees available at cost to CAST. And finally, thanks are due to members of CAST. The unrestricted contributions they have made in support of the work of CAST have financed the report.

The report is being distributed to members of Congress the S. Department of Agriculture, the media and institutional members of CAST Individual members may receive a copy on request.

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Charles A. Black
Executive Vice President
Council for Agricultural
Science and Technology

SUMMARY

Conventional and organic farming have much in common. They differ principally in the use of modern chemical technology. Conventional farmers use commercial fertilizers, pesticides and animal feed additives to increase productivity but organic farmers prefer to use natural resources.

Organic farming, though ancient in principle, was described as a system prior to World War I by Sir Albert Howard. He taught that, except for "natural" products such as phosphate rock and limestone, importation of plant nutrients from off the farm for application to the soil is to be avoided. This judgment about the acceptability of naturally occurring chemicals has now been expanded by many the organic movement to nclude the issue of safety They regard natural chemicals as safe, and chemicals that are artificial, synthesized or processed as hazardous and therefore to be avoided. This view is scientifically erroneous.

Sir Albert Howard regarded the return of organic matter to the soi as the basis of permanent soil fertility. This concept has some validity for natural ecosystems, but it is inapplicable to the needs of modern society which the harvested portion of crops is removed from the and and part of the organic matter and plant nutrients is not returned.

The organic farming movement has expanded to encompass an alternative agricultural system based upon less technology; more self reli and opposition to the trend toward larger farm enterprises, displacement of small farmers, and the deterioration of some rural institutions.

Organic farmers prefer to use leguminous crops, a natural resource, to supply part of the nitrogen needed for their cropping systems, whereas conventional farmers supplement or replace the legume nitrogen with fertilizer nitrogen, which nowadays is produced in factories. For conventional farmers this is essentially a matter of economics because they can replace legumes with profitable crops. earlier years, when nitrogen ferti izer was relatively expensive, conventional farmers also used legumes to supply nitrogen; they sti do where is economical

Both conventional and organic farmers use various mechanical, biological and other means to control pests, including weeds nsects, disease-causing agents and nematodes. Conventional farmers use synthetic pesticides as needed for pest control, but organic farmers prefer to avoid them.

Both conventional farming and organic farming are largely powered by fossil fuels but conventional farmers use more energy per acre than do organic farmers, largely because they use fertilizers and pesticides. These products mainly nitrogen fertilizers, consume about 1 percent of the energy used nationally but about 40 percent of the energy used in agricultural production. Conventional farmers use the extra energy primarily because it is economically advantageous.

In conventional farming, extensive use is made of nutritional supplements in animal feeds. Further increases in production efficiency are achieved by use of hormonally active substances. Certain drugs approved by the Food and Drug Administration are used to protect animal health and to increase production efficiency. Use of these substances is generally unacceptable to organic farmers.

If organic farming were widely adopted, the current price advantage to certain organi farmers from supplying a specialty market (made up of persons willing to pay relatively high prices for foods produced by "organic" or "natural" methods) would disappear. At the same time, there would be an increase in (a) income to farmers in the aggregate, (b) costs of food to consumers, (c) land values, (d) demand for (and wages of) farm labor and (e) soil erosion. In the long run, the balance of payments earned by export of agricultural products would decrease. These effects would flow from the decrease in production and the cultivation of addi ional more strongly sloping land that is less suited to production of row crops than the land now cultivated.

Both organic and coventional farmers are served by mos current agricultural research, but research on commercial fertilizers and pesticides mainly benefits conventiona farmers. In earlier years most of the research done was on subjects that are now considered part of organic farming.

Organic gardening is considerably more attractive and feasible than is organic farming. The reasons are (1) the ease with which the organic matter grown the garden may be supplemented with organic matter grown elsewhere, (2) the feasibility of manual weed control, (3) the ability to choose those fruits, vegetables and ornamentals that can be grown satisfactorily without pesti ides and (4) the abil ty to purchase the needed products without suffering a financia disaster if the yield is poor or if part of the produce is destroyed by pests.

OVERVIEW

In crop and livestock production practices, conventional and organic farming have more in common than not. The principal divergence is in the use of modern chemical technology. Conventional farmers use fertilizers, pesticides and animal feed additives where they seem useful, but organic farmers prefer to avoid them.

The competitive, free enterprise system encourages individual conventional farmers to adopt technological innovations that increase thei production and make it more efficient In recent years, number of the innovations have involved of chemicals.

Many current proponents of organic farming would like to see less free play of market forces (which have led to larger farms), less specialization, and less dependence on technological inputs in farming. They would like to reduce the displacement of small farmers and what they see as a decline in some rural institutions.

The goal of organic farming was initially to formulate the best possible system for producing food in where neither transportation money available to acquire production aids such as commercial fertilizers from outside sources. Overlaid the original objective of organic farming, however, was the judgment that, except for "natural" products such as phosphate rock and limestone, importation of plant nutrients from off the farm for application to the soil is morally undesirable. In modern years, this judgment has been extended to include use of agricultural chemicals in general.

The organic movement commonly uses the word "organic" as a synonym for "natural," and it regards "organically grown" food as superior nutritionally to conventionally grown food. Scientifically, natural substances are not necessarily organic, and organic substances are not necessarily natural. As far as is known, conventionally grown plants are just as organic and just as nutritious as are organically grown plants, and both absorb virtually all of their supply of nutrients from the soil in inorganic forms.

The judgment about the acceptability of naturally occurring chemicals for use in agriculture has now been expanded by many in the organic movement to include the issue of safety. Natural chemicals are regarded as safe; chemicals synthesized by humans are considered hazardous. Scientifically, if a specifi chemical compound is synthesized in living organism, is identical to the same compound synthesized in aboratory. Where or how the chemical is synthesized is irrelevant as far as ts properties and effects are concerned. A given use or given human exposure produces identical effects rrespective of the origin of the chemical For example, the "natural" methanol or wood alcohol that in strawberries is the same as the "synthetic" methanol produced industrially by combining carbon monoxide and hydrogen. Methanol from both sources would cause blindness if ingested in excess, but the methanol in strawberries is safe because it occurs only in traces and would be ngested only in nontoxic amounts even if one were to eat nothing but strawberries.

Scientifically, hazard is determined by the toxicity of a substance and the exposure to it. Whether the substance is of natural or synthetic origin is irrelevant. Some natural chemicals, including organic chemicals synthesized by living organisms, are extremely toxic to humans, and some are essentially inert in the human body. The same is true of chemicals synthesized laboratories or factories.

The judgment that importation of plant nutrients in the form of natural substances such as phosphate rock and limestone a desirable practice, whereas importation of nutrients in the form of commercial or "artificial fertilizers not, is to be regarded as arbitrary distinction, not a scientific distinction. Both organic and conventional farmers use limestone on their soils when needed; organic farmers and some conventional farmers use phosphate rock.

The founder of organic farming Sir Albert Howard, considered that the basis of permanent soi fertility is the return of organic matter to the soi This is concept with some validity for natural ecosystems, but it is napplicable to the needs of modern society in which the harvested portion of crops is removed from the and and part of the organic matter and plant nutrients is not returned. Under current practices the amount of organic matter returned to the soil s frequently greater in conventional farming than in organic farming because of the greater yield.

Organi farmers prefer to use phosphate rock and potassium salts as mined to provide supplemental phosphorus and potassium, whereas conventional farmers use mostly processed forms in commercial fertilizers. Commercial phosphorus fertilizers have greater solubility and availability to plants than does phosphate rock, and they often contain phosphorus in higher concentration. Commercial potassium ferti izers contain potassium in higher concentration than do potassium salts as mined, but both are relatively soluble and available to plants.

To meet nitrogen needs, organic farmers prefer to use leguminous crops, which have the capability to remove nitrogen gas from the atmosphere and convert it to nitrogenous compounds useful to the crop. The nitrogen left behind by leguminous crops supplies part of the needs of the succeeding nonleguminous crops, and the cropping system is built around the legumes as a source of nitrogen. Conventional farmers used to follow the same practice because commercial nitrogen fertilizer was too expensive to compete with legume nitrogen. After World War II, fertilizer nitrogen became available in increasing quantities at relatively low prices. To meet the nitrogen requirements of their nonleguminous crops, many conventional farmers then substituted fertilizer nitrogen for a part or all of the legume nitrogen and added extra fertilizer nitrogen to the extent that seemed economically advantageous. The resul has been a more than tenfold increase amount of nitrogen fertilizer used per year and decrease in use of legumes to supply nitrogen.

Nitrogen and other nutrients are returned to the soil in animal manure in both conventional and organic farming, but manure returns only a part of the nutrients removed by crops. The total amounts of nitrogen, phosphorus and potassium added in manure are small in comparison with the amounts of these nutrients supplied in commercial fertilizers.

Synthetic pesticides were of little significance in agriculture in Si Albert Howard's time, but they are of great significance today in conventional farming. Organic farmers, however, prefer not to use them.

On most farms, the principal agricultural pests are weeds. Both conventional and organic farmers use a variety of weed-control practices, and conventional farmers make extensive use of herbicides. Herbicides are applied both to prevent weeds from emerging and to kil those that have already emerged. Herbicides are most useful for controlling weeds that cannot be killed by mechanical cultivation--weeds that grow in crop rows and in crops that are not cultivated. Weed control by herbicides is especially important for small-seeded crops that would otherwise require hand labor to remove the weeds growing in the rows.

Both conventional and organi farmers use a variety of methods to control nsects. Insecticides are usually used by conventional, but not organic, farmers to control insect infestations that have already devel oped The desirable practice is to make applications only when the infestations are sufficient to cause significant economic losses not checked. The current trend toward ntegrated pest management or IPM, which attempts to put together the optimum combination of practices for insect control, is trend away from reliance on chemicals. Insecticides re used when needed, however, and so integrated pest management not acceptable to organic farmers who avoid their use.

The most important biological means of controlling insect disease and nematode pests is development of resistant crop varieties. This technique has had greatest success in controlling diseases, and used by both conventional and organic farmers Some vegetabl crops are susceptibl to diseases for which there is no feasible control except fungicidal sprays and only conventional farmers can grow these crops successfully. Also, treating seed with a smal amount of an appropriate fungicide mproves seedling establishment, especially in years when the soil is cool and wet at planting time. At present there is no effective substitute for such seed treatment.

Nematodes that attack crop roots can be controlled to some degree by crop rotation and suitable tillage (resistant varieties are available for a few crops), but of nematicides often results in increased crop yields that could not have been achieved by any alternative method

In conventional farming, chemical sprays are sometimes used near harves to cause plants to dry out or to drop thei leaves With a number of crops, including cotton, potatoes beans and sorghum, this practice has several economic and biological advantages. Chemicals are used also to protect fruits and vegetables from diseases that cause decay; this permits shipment of fresh produce from one section of the country to another for year-around availability.

The produce from organic growers is often sold at relatively high prices to persons who are willing to tolerate imperfections in return for ass that commercial fertilizers, pesticides and additives have not been used. Although analyses of "organic" products for pesticide residues indicate that the faith of consumers in the claims is not well placed the residues, which are monitored by the Food and Drug Administration, have been found in only very small quantities and present no significant hazard to public health.

As energy became a national issue, so also it became a basis for debate of conventional vs. organic farming. Both conventional and organic farming are largely powered by fossil fuels, but conventional farmers use more energy per acre than do organic farmers. Of principal concern in the debate is the energy used for fertilizers and pesticides because organic farmers prefer not to use these products. Fertilizers accounted for an estimated 33 percent of the total energy input in production agriculture in the United States in 1974, and the production of pesticides accounted for 5 percent. Agricultural production consumed 3 percent of the total amount of energy used in the United States, which means that fertilizers and pesticides accounted for about percent of the energy used. As may be nferred from the next paragraph, however, adopting organic farming methods would not decrease the national energy utilization by 1 percent if additional and with lower yielding capability were farmed to make up for the lower yields obtained with organic farming.

Adoption of organic methods by farms now using a mixed grain-livestock system would result in decreases in crop yield estimated at 15 to 25 percent per there were little or no change in cropping pattern If nonlivestock farms were to adopt organic methods there would be a considerably greater decrease in total U.S. yield of the high-value crops because the acreage of these would be reduced by introduction of legumes nto the crop rotation to supply nitrogen. To offset a 15 percent decline in production on present land from adoption of organic farming methods would require 18 percent more of the same kind of land to produce the output obtained by conventional methods. Because currently this amount of the same kind of land is not available, the additional land would be less productive, and more of it would be needed. If legumes were to become part of the cropping sequence on intensively cropped, nearly evel land, more row crops woul have to be planted the sloping land to maintain the output; this would mean increased erosion

In conventional farming, extensive use is made of nutritional supplements in animal feeds. Mineral and other nutritional supplements increase animal productivity and they are of greatest importance in feeds for poultry and swine In cattle feeding, considerable use i made of urea as an economical, nonprotein source of itrogen. The minerals and nonprotein nitrogen used to improve the nutritional quality of animal diets conventional farming improve also the quality of the fertil because much of the quantity of the nutrient elements supplied in the feed excreted in the

Further in production efficiency are achieved modern conventional animal agriculture by use of hormonally active substances. Some of these substances increase the rate of gain and reduce the amount of feed required per pound of body weight gained by 10 to 15 percent.

Certain drugs are now approved by the Food and Drug Administration for use to protect animal health and to increase production efficiency. Drugs are useful i both conventional and organic systems of farming, but organic farmers prefer not to use them.

If organic farming were widely adopted, the price advantage to organic farmers from upplying specialty market would disappear but the income to farmers in the aggregate would increase, and the costs of food to consumers would ncrease The principal reason is that total production from the and under cultivation the time of the change woul decrease, and the percentage increase in price of agricultural products would exceed the percentage decrease in production. Increased net farm income would lead to higher land values throughout the United States. Thus,

current landowners would benefit, but additional financial constraints would be imposed on the entrance of potential new farmers

Widespread adoption of organic farming would encourage cultivation of additional, less productive land that is not now cultivated. The additional labor required to farm this land, plus whatever increase in labor intensity might be needed for use of organic methods on land previously cultivated by conventional methods, would cause the demand for, and wages of farm labor to increase. Exports of agricultural products would be adversely affected. One national model indicates that, in 1980, the amount of wheat plus corn available for export would be 4.6 bi lion bushels under conventional farming and 0.9 billion bushels under organic farming. In the long run the price increases resulting from decreased production woul courage importing countries either to increase their own production or to seek other sources thus reducing the dollar value of U.S. agricultural exports and increasing the balance-of-trade deficit.

Both organic farmers and conventional farmers are served by most current agricultural research, but research on fertilizers and pesticides mainly benefits conventional farmers. In earlier years, much research was done on subjects that are now considered part of organic farming.

Now receiving emphasis in fundamental nitrogen research is the means of developing the capability of nitrogen fixation in nonleguminous plants. Although success in this endeavor is not soon anticipated, it would put the controversy between organic and conventional farming in quite a different light than that in which it is viewed at present

Considerable research is being conducted also on "conservation tillage" methods. Except for the use of herbicides, some of these methods are more "organic" than the usual organic farming in that they use less tillage (and hence, produce less rapid decomposition of soil organic matter) and produce more legumes than the usual organi farming.

Organic gardening i more attractive than organic farming. The most important distinction is the ease with which the organic matter grown in the garden itself may be supplemented by organic matter derived from other sources. The organic matter contains plant nutrients and reduces the need for fertilizers. If there is much extra organic matter, it is best handled by composting it temporarily.

A second distinction between organic gardening and organic farming is that gardening without use of herbicides to control weeds is much easier than farming without herbicides because weeds can be controlled manually and by mulch systems on the smal areas involved. third distinction is that organic gardeners have greater freedom of choice than do organic farmers in the fruits, vegetables and ornamentals they grow. Organic gardeners can select the plants they can grow satisfactorily without pesticides A fourth distition is that, if the yield is poor or if part of the produce is destroyed by pests, the organic gardener can purchase the needed products without suffering a financial disaster.

INTRODUCTION[1]

The basic concern of this report is the agricultural systems by which food and fiber are produced. Agricultural systems have been evolving through the years with the introduction of technology that has been adopted because of the profitability it offered to ndividual producers. The outcome of the continuing adoptions of new technology in the competitive, free-enterprise system, however, has been the transfer of most of the financial benefi to consumers in the form of low prices for food purchased domestically, plus additional national income from food exports

During the past three decades changes in agricultural technology have been pronounced, and much of the increased productivity that has occurred is consequence of use of chemicals. With these changes has developed increasing public concern about the safety and quality of the food and about the systems by which food is produced. Agricultural production systems have been questioned on such grounds as their direct effects on long-term soil productivity and energy utilization as well as their indirect effects on wildlife, water quality and other aspects of environmental quality.

Viewed by some as an important, if not essential, substitute for conventional modern agriculture with its industrialization and technological inputs is an alternative system of agriculture, commonly termed "organic." Organic farmers, by and large, accept without question the advances in applied genetics and biology, and accept to varying degrees the mechanization, but prefer to avoid the use of chemical technology. In the words of Robert Rodale (State of New York, 1972), a journalist who is regarded as the current leader of the organic movement in the United States,

> Organically grown food is food grown without pesticides; grown without artificial fertilizers; grown in soil whose humus content is increased by the additions of organic matter; grown in soil whose mineral content is increased with applications of natural mineral fertilizers; has not been treated with preservatives, hormones, antibiotics, etc.

The "organic" movement is controversial, and the scientific, economic and sociological bases for conventional farming and organic farming are not well known to many persons who are concerned with the controversy. Hence, the purpose of this report is to provide factual information on the subject that should be helpful as a basis for understanding and rational decision-making.

We shall discuss first the evolution of the two systems. Next shall discuss their commonality, the problems that exist in terminology and value judgments, and the scientifi basi of what perceive the principal controversia issues Then we shal discuss the implications of increased adoption of organic farming methods, and organic farming research. At the end, we shall discuss organic gardening. The reason for considering organic gardening separately from organi farming is that, although organic gardeners tend to share Rodale's philosophy about the way food should be produced, the physical and economi circumstances related to organic gardening are different from those of organic farming. In other words, organic gardening is not to be regarded as small-scale organic farming.

EVOLUTION OF FARMING SYSTEMS

This document is concerned primarily with the agronomic, economic and environmental aspects of conventional and organi farming systems. nsofar as feasible, broader sociological implications are taken into account; but these are less well researched, exceedingly complex, and far more controversial. As an aid to understanding the differences between conventional and organic farming, may be helpful to review the origins of, and motivations behind, the two systems.

Conventional Farming

The production methods currently employed in much of U.S. commercial agriculture developed in response to a market economy based on profit incentives. Through the competitive, free-enterprise system, agriculture has been encouraged to move in the direction of greater production and greater efficiency of production, specifically:

1. To produce food in greater quantity and with better quality. The food supply in the United States has consistently met the needs of our ncreasing population and has provided for tinuing improvement in the quality of the diet. In many countries nutritional deficiencies from nadequate food supplies are still leading causes of disease and misery.

2. To substitute machinery and pesticides for human and animal labor. The consequence has been a reduction of drudgery, the release of workers for industrial and other manpower needs, and the release of land to produce food for humans instead of feed for work animals.

3. To increase per acre yields on cropland. The consequence has been less need for farmland and greater availability of land for other purposes including forests, parks, conservational areas, home sites, highways and industry.

4. To broaden the available food selection. The consequence has been an improvement in the nutritional quality of the diet and an enhancement of the pleasure of eating.

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[1] While this report was in galley proof, a USDA publication on the same subject appeared in print (Papendick et al., 1980).

5, To protect food commodities from insects, diseases and nematodes. The consequence has been improved capability to transport the commodities considerable distances and/or to store them for long periods so their use is not limited to local consumption soon after harvesting. Today, there are often great distances between where food is produced and consumed. (Of course, many vegetables and most fruits are still most flavorful when harvested fully ripe and eaten at once.)

Despite their willingness to adopt new technologies that help to keep them competitive, conventional farmers continue to associate good soil management with maintenance and improvement of soil fertility, with addition of organic matter to the soil, and with use of soil conservation practices. For economic rea- however, neither conventional farmers nor organic farmers in the aggregate use the best soil conservation practices available.

Organic Farming

The organic farming concept, though ancient in principle, was enunciated as a defined system prior to World War I by Sir Albert Howard, Director of the Institute of Plant Industry in Lahore, India. His goal was fundamentally economic: to formulate the best possible system for producing food in areas where neither transportation nor money was available to acquire production inputs such as fertilizers from outside sources. The contemporary organic farming movement in the United States traces to J. I. Rodale (now succeeded by his son, Robert) who began publishing a magazine on the subject in 1942.

As an aid in understanding the arguments for organic farming, it is helpful to consider the social movements from which organic farming is derived and by which it is reinforced. Organic farming in the contemporary context may be regarded as part of a larger social movement that has been termed the "alternative agriculture movement this includes the "biodynamic/ French ntensive method" (Jeavons 1977, 1979) and numerous unnamed variations

This movement emerged on the heels of environmentalism in the late 1960s, although alternative agriculture has had a longstanding constituency The larger movement is rooted in two major social of its proponents: (1) that techniques of modern agriculture involve significant environmental and health risks (e.g., in the words of Robert Rodale (State of New York, 1972) "Agriculture is now a major source of pollution in this country, and we are not going to want that to continue. The organic method is the only non-polluting form of agriculture....") and (2) that the structure of modern agriculture (i.e., increasing farm size, specialization, uprooting of farm people) has undesirable social consequences for some people and rural communities (Goldschmidt, 1978; Perelman, 1977).

A principal characteristic of social movements is that they seek social change away from present institutional arrangements; this desire for change tends to be interpreted by "outsiders" as being irrational and unnecessary. However, it should be kept in mind that most social movements tend to emerge in response to needs perceived to be legitimate by their leaders.

Typically, the advocates and detractors of a given movement make claims and arguments for thei cause that may be nterpreted as 'extreme. Critic and defenders of U.S. agriculture tend to follow this pattern as they seek to support their points of view. Further, each side tends to inflate the claims made by the other to make ts refutations and counter-arguments more persuasive. As a result, both organic and conventional agriculture must be evaluated in a somewhat less polarized sense than is apparent at first glance.

Generally, the alternative agriculture movement includes a complex collection of persons and organizations, as well as practices, goals and tactics. The production practices of organic farmers are incredibly varied--depending largely on the stage of transition away from use of chemical technology, size of the farm operation, nature of markets, climate, soil etc.

Garth Youngberg (1978) argues that "Alternative agriculturalists are not well organized." They have no national umbrella organization and virtually lack state- or Washington-based lobbyists. In fact, most movement adherents tend to be skeptical of such a centralized organization approach on ideological grounds.

This ack of movement organization is surprising considering the apparent number of movement supporters; for instance, over one million persons subscribe to *Organic Gardening*. However, the actual number of organic farmers is small--probably 15,000 or less (see Youngberg 1978). Much of the support for the alternative agriculture movement is from persons skeptical about the safety of conventional food, certain consumer groups, research and advocacy organizations, and some environmentalists.

COMMONALITY OF CONVENTIONAL AND ORGANIC SYSTEMS

Although the controversy between proponents of organic and conventional systems of farming may at times become heated, the fact .. that there is more commonality between the systems than might be inferred from the arguments. For example, to comment on Rodale's (State of New York, 1972) description of the system by which "organically-grown food" is produced, we would note that "natural mineral fertilizers" that perform satisfactorily are used by some conventional farmers as well as organic farmers. Limestone, a naturally occurring substance, is applied to acid soils by both conventional and organic farmers. Limestone is a source of calcium and, often, magnesium as well. Organic matter is added to soil in both conventional and organic farming. In both conventional and organic farming, the soil "humus" is derived from plant materials and from animal manures, which in turn were derived from plant materials.

Rodale's description of the system for producing organi food is couched in terms of technological inputs rather than actual operations, and it tends to obscure the fact that neither conventional farming nor organi farming is distinct entity. Farming involves many practices, and these vary with the circumstances and with the farmer, whether the individual

concerned is regarded as a conventional farmer or an organic farmer. Moreover, certain practices that are appropriate for the conditions and objectives of the operation tend to be common to both conventional and organic farmers. These practices include returning croo residues and animal manures to the soil; growing leguminous crops; using similar breeds of livestock, types of machinery, crop varieties, and methods and rates of planting; and using similar times and methods of harvesting, drying, storing and marketing the products.

ORGANIC AND SCIENTIFIC TERMINOLOGY

The crux of Rodale's description of the system by which organically grown or organic food is produced is the negative parts that apply to chemical technology and serve to define organic farming in terms of nonuse of such technology. We shall now examine in brief the organic and scientific terminology as related to the chemical technology of agriculture, an exercise that will lead to further appreciation for the considerable commonality of organic and conventional farming.

The terms "natural" and "organic" are often used interchangeably in the terminology of organic farming, but not in the terminology of science. In the terminology of science, organic chemistry is the branch of chemistry that deals with carbon compounds. Many such compounds occur in nature, and many are synthesized in laboratories and factories. (Certain simple compounds of carbon such as carbon monoxide are generally considered to be inorganic.) But many inorganic or "nonorganic" compounds also occur naturally, and they occur along with organic compounds in many substances, including our bodies, foods and soils Hence, in scientific terminology, natural compounds are not necessarily organic, and organic compounds are not necessarily natural.

When chemistry was i its infancy, chemists did indeed believe that organic compounds coul be produced only in the presence of a vital force found in living organisms, and it was in those days that the term "organic chemistry" was developed. This misconception fell in 1828, however, when the German chemist Wöhler synthesized urea, an organic compound, in the laboratory.

Urea may be used to illustrate certai scientific inconsistencies in terminology and judgments made by those associated with organic farming Urea is a natural organic waste product of human and animal metabolism that contains 47 percent nitrogen by ight. It is present in animal excreta voided and, hence according to Rodale's definition of organically grown foods quoted in the introduction of this report it should qualify as natural, nonartificial nitrogen fertilizer for producing organically grown foods. According to the same definition, however, the urea that is synthesized in factories which is chemically identical to the urea produced by human and animal metabolism and is widely used nitrogen fertilizer in conventional farming, is not acceptable nitrogen ferti izer for producing organically grown foods because it is "artificial."

To carry the analysis one step further, the urea in both animal manures and commercial fertilizers undergoes rapid enzymatic hydrolysis in the manure or the soil to ammonium carbonate. The ammonium is transformed further to itrate, and most of the urea-derived nitrogen absorbed by plants is taken up as nitrate. The ammonium and itrate derived from urea produced in fertilizer factories are indi tinguishable from the ammonium and nitrate derived from urea produced in humans and animals, and both these ions are inorganic, not organic. Therefore, in scientific terminology, the organically grown food produced with urea derived from animal as a nitrogen source is actually "inorganically grown.

Although the various plant nutrients behave differently, there is no evidence that "organically grown" plants are organically nourished. The evidence is that they are mostly inorganically nourished and that the same is true whether plants are grown by conventional or organic farming methods.

The nutrients that are essential for plant growth are present in living plants partly in organic form and partly in inorganic form, and the same true when the plant residues are added to the soi either directly or after passage through animals. f present initially in soluble inorganic forms, the nutrients added to the soil in these organic material mi promptly with the inorganic forms of the nutri ents in the soil solution; or they mix gradually they are present initially in organic forms and changed to inorganic forms during decomposition by the microorganisms that live in the soil. The quantities of the nutrients supplied by the soil, previous generati ns of plants e and commercial fertilizers al contribute to mixture of inorganic nutrients that nourishes the next generation of plants. The potassium for example that is present in the soil solution is chemically the same, whether it comes from one of these sources or another, and plants do not distinguish among the potassium ions they absorb from the various sources.

Under some circumstances, certain micronutrients such as ron and inc can be applied to soils and absorbed by plants effectively in simple synthetic organic forms (chelates than in inorganic forms be- of rapid nteraction of the inorganic forms with the soi to reduce their solubility, but it is not known that such mechanism mediates the uptake of these elements by plants growing in soils in the absence of added chelates. If it does, it should operate under both conventional and organic farming.[2]

There is no evidence that humus as such is required for plant growth. Higher plants and certain microorganisms can make good growth on solutions of inorganic nutrients (hydroponic cultures) to which no organic matter is added.

Finally, we turn to "organic food," which is a product of organic farming. In scientific terminology, foods are composed of chemicals. Most foods contain many chemicals, and most of these are organic chemicals, whether the foods are produced by conventional farmers or organic farmers. For example, more

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[2] The combined results of 47 experiments in six southeastern states show that the iron content of turnip greens increased significantly with the organic matter content of the soil (Speirs et al., 1944).

than 100 organic chemicals have been identified in the tomato (Buttery et al., 1971), and more than 150 in the potato (Talburt and Smith, 1975).

Plants may absorb simple, soluble organic substances through the roots, but such substances are not normally present except in trace quantities in soils, whether conventionally farmed or organically farmed, and they are not known to be absorbed in more than trace quantities by plants. Virtually the total amount of the organic chemicals that constitute upwards of 95 percent of the dry weight of most plants (and all of that produced in plants grown on solutions of inorganic nutrient salts) is synthesized by the plants themselves, and there is no evidence that conventionally grown and organically grown plants differ in this regard. Thus, as far as is known, conventionally grown plants are just as organic in the scientific sense as are organically grown plants. Moreover, there is no evidence that plants synthesize a different set of organic compounds when they are organically grown than when they are conventionally grown.

Although organically grown foods are sometimes said to be superior in nutritive value to conventionally grown foods,[3] this allegation has yet to be sustained experimentally.[4] The available evidence, obtained from chemical analyses and animal feeding trials, indicates that the nutritive value of organically grown and conventionally grown foods is about the same (Appledorf et al., 1973, 1974;[5] Arnon et al., 1947; Brandt and Beeson, 1951; College of Agriculture, Michigan State University, 1955; Schuphan, 1974).

Additional experiments with ample supplies of nutrients but different modes of pest-control would supply information on the implications of the pest-control aspects of organic versus conventional methods for food quality. As may be inferred from page 18 of this report, there is no evidence that residues of modern pesticides in foods have any detrimental effect on human health. There is ample evidence, however, that numerous illnesses and deaths of domestic animals and humans caused by mycotoxins in feeds and foods could have been prevented by suitable use of pesticides and decontamination treatments (Diener et al., 1979).

ISSUE NO. 1: SOIL FERTILITY

According to an article written by Robert Rodale (1973),

> the basis and enduring foundation of the organic farming system (Sir Albert Howard) created was the placing of first priority on the building of soil fertility more by completing the cycle of organic life, and less by using fertilizers imported from other regions.... It was Sir Albert Howard's special contribution to emphasize that the continual and enthusiastic replenishment of soil organic matter could create a permanently productive kind of agriculture that didn't need to rely on imports of fertilizer from outside the farm to maintain fertility year after year. He did recommend the use of mild and natural soil conditioners--such as limestone and phosphate rock--to supplement the release of nutrients from the average soil's impressive store of insoluble reserves.

Quoting from the book *The Soil and Health* by Sir Albert Howard, Rodale continued:

> Having exhausted the possibilities of production from his own fields, he (the farmer) has actually had the temerity to transfer to those fields the stored-up natural wealth, representing centuries of accumulation, lying many thousands of miles away. The importation of feeding stuffs, of guanos and manures of all kinds from distant parts of the world is only robbery on a vast scale. It is not necessary to claim that every national agriculture must be completely self-contained: This would be a great pity. But the tide has been all one way.

Although the view that importation of nutrients and feedstuffs (which contain nutrients) is robbery is inconsistent with the recommendation that phosphate rock and limestone be imported for addition to soil,

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[3] For example, in a public hearing on organic foods (State of New York, 1972), Robert Rodale testified that "... there are many factors that influence the nutritional value of food and many of these factors are part of the organic system.... Now, if a farmer wants to produce food that is nutritionally superior, he can use all varieties of methods and do that.... And organic farmers are encouraged to use as many of these methods to improve nutritional value as they can practically, and it is absolutely incorrect as some people have said here this morning that there is no difference in the nutritional value."

[4] Conversely, conventional foods are sometimes said to be lacking in nutritional value because the fertilizers added to soils to aid in plant production do not contain all the nutrients plants need. This allegation similarly has yet to be sustained by experimental evidence. It is true that commercial fertilizers do not contain a complete assortment of nutrients, although they could and, in fact, they do when plants are grown hydroponically. It is equally true that "natural mineral fertilizers" favored by organic farmers do not contain a complete assortment of nutrients. When both conventional and organic farmers add nutrients to soil, the objective is to supply the plants with the nutrients that are deficient in the soil, as indicated by increases in yield associated with application of the nutrients. As deficiencies of more nutrients develop, a wider assortment of nutrients is required.

[5] Appledorf et al. (1974) purchased 25 pairs of standard food items in "health" food stores that sold their foods as "natural" or "organic" (personal communication) or in supermarkets and had them evaluated by sensory perception. The panel ranked about half of the supermarket items significantly above their natural or organic counterparts in overall acceptance. None of the natural or organic food items was found superior to the supermarket items in overall acceptance.

the Howard-Rodale philosophy seems to equate soil fertility maintenance with the return to the soil of organic matter produced by plant growth on the soil. There is much truth in this philosophy for natural conditions in which crops are not removed, but it is fallacious where agriculture is concerned.

Under natural, nonagricultural conditions, the nutrients that are removed from the soil by plants are returned to the soil along with the organic matter produced by the plants, and there is generally an effective recycling process so that losses of nutrients by leaching and soil erosion are relatively small. Soil fertility is then maintained with but slow change at whatever level is characteristic of the soil in question.

Crop production in both conventional and organic farming brings about a much more rapid depletion of nutrients because parts of the crop are removed and used for animal feed or human food. Although organic farmers and most conventional farmers return to the soil the portions of the crop that are not harvested and the manure from any livestock, thereby returning both organic matter and nutrients, much of the quantity of nutrients removed in the harvested portion of crops is not returned to the soil from which the nutrients were removed. If importation of organic matter and nutrients from other areas is to be looked upon as robbery, a practice in which one should not ethically engage, the fertility of soils used for crop production then declines. How soon the depletion of nutrients is reflected in decreased crop yields will depend on the circumstances.

The organic matter returned to the soil in both conventional and organic farming will maintain the content of organic matter in the soil at a level that in most instances is much lower than that which existed under the uncultivated, uncropped condition. In comparing the impacts of conventional and organic farming on soil organic matter, therefore, an important question is the relative amounts added in the two systems.

Surprisingly, decomposition of the unharvested portions of the crops in a conventional farmer's wheat-corn-soybean rotation results in about the same addition of humus (1433 pounds per acre) as do the crops in an organic farmer's rotation of corn-wheat-alfalfa hay (1533 pounds per acre) if the yields of corn and wheat are the same in the two rotations. See Table 1. A crop of oats returns slightly less humus than wheat. And corn harvested for grain contributes more to the soil humus supply than does corn harvested for silage, even taking into account the manure returned to the soil.

News stories describing large increases in soil organic matter due to adoption of organic farming suggest deficiencies in sampling, testing and understanding. For example, an Iowa report (Yacknin, 1978) stated that the soil humus content on one organic farm had been raised from 1.8 percent in 1967 to 6.7 percent in 1977. That corresponds to a net gain of about 13,000 pounds of humus per acre per year to a depth of 8 inches (see Table 1 for more realistic values for humus additions). Information supplied, however, indicates that the additions of organic matter from

Table 1. Estimated additions of humus to the soil by several crops (Lucas et al., 1977)

Crop and yield of harvested portion[a]	Estimated humus additions from indicated portion of plants, lb/acre[b] Above ground	Below ground	Total
Corn (only grain removed)			
100 bu/acre	1240	670	1910
Soybeans (only grain removed)			
32 bu/acre	660	310	970
Wheat (only grain removed)			
45 bu/acre	930	520	1450
Field beans (only seed removed)			
15 cwt/acre	410	150	560
Alfalfa (first year, only hay removed)			
3 T/acre	230	1010	1240

[a] Values in this column are yields of the portion of the crop harvested and not returned to the soil, expressed with the standard moisture content for the air-dry product.

[b] Values in these columns are based on the assumptions that 30 percent of the carbon in the plant residues added to the soil becomes humus and that humus contains 58 percent carbon.

crops grown and from animal manures would be sufficient only to offset approximately the losses of soil humus due to decay and soil erosion.

Probably due in large part to the use of conventional farming methods, the present trend n terms of plant and animal residue additions to the soil is upward rather than downward, even in the Corn Belt. In Illinois, for instance, the amount of residue added all forms, including green manure crops and animal manures (not including weeds) today is estimated 60 million short tons, compared with 31 million tons in 1950 and 30 million in 1920,[6] when the practices then used by many of the farmers would be considered to be organic farming in current terminology. Furthermore, the additional fertilizer nitrogen (approximately 900,000 tons in 1978) helps convert the highly carbonaceous residues into humus.

On the other hand, one might expect that the increase in row crop acreage associated with conventional farming would lead to greater loss of humus through erosion. Stall and Lee (1978) found that soil losses from the more rolling watersheds in Illinois were indeed increasing, whereas the losses from the more level, most intensively cropped watersheds, though serious, were on a downward trend.

The evidence in the preceding paragraphs does not support the view that conventional farming and organic farming differ greatly in their effects on soil organic matter. In general, conventional farming probably adds more organic matter than organic farming because crop production is greater. And, in general, the loss of organic matter by soil erosion is probably greater with conventional farming than with organic farming.

Tillage, practiced in both conventional and organic farming (more in the former than in the latter), generally increases soil erosion and microbial decomposition of humus in the soil Today, however farming systems involving reduced tillage, even no tillage, are gaining favor with many farmers because these systems reduce soil erosion, save labor and energy, conserve moisture and improve soil tilth. These improvements in practice are most acceptable to conventional farmers because less tillage and more crop residues on the surface of the soil often require the use of additional pesticides to control weeds, diseases, nematodes and insects--a tradeoff not considered appropriate by organic farmers.

ISSUE NO. 2: SAFETY OF CHEMICALS

Many proponents of organic farming are concerned about possible adverse effects of "synthetic" or "nonorganic" (man-made) pesticides and fertilizers. "Natural" or "organic" substances are considered safe, whereas those synthesized or processed by humans are viewed as harmful. In some instances, this distinction may be related to a fear of chemicals without due appreciation of the fact that all substances are made up of chemical .

The argument is expressed in various ways by various persons. In the words of Barry Commoner (1979), for example, "Every compound that's made in living things has to be compatible with life.

The fact is that some chemicals synthesized by living things are produced in sufficient quantities to harm the organisms that produce them. Alcohol is an example If enough fermentable material is present, the yeasts that form alcohol are eventually killed by the alcohol they produce.

And some chemicals produced by certain living things are toxic to other living things. Antibiotics are an example. These are chemicals produced by certain microorganisms (some are now produced synthetically) that limit the growth of other microorganisms or actually kill them. We use the ones that are sufficiently compatible with human and animal life to produce more benefit than harm. Mycotoxins are another example. These chemicals produced by fungi (molds) sometimes result in illness and death of animals and humans. Mycotoxins may produce birth defects, spontaneous abortions, tremors, cancers and other effects. One of these substances, aflatoxin B_1, is the most potent, naturally occurring, cancer-producing substance known (Diener et al., 1979).

Poisonous plants are common, and they are frequent causes of abortion, sickness, and death of livestock, particularly those that graze on natural range vegetation. Humans also may be affected. Even plants that are commonly eaten as human food, and are not regarded as poisonous, contain many chemicals, each of which would have detrimental effects in excess, and some of which would be poisonous in only small quantities. The Irish potato is an example. The potato contains compounds known collectively as solanum alkaloids (or solanine) that are toxic to humans if ingested in quantities considerably greater than those we normally get in potatoes. In earlier years, when peopl ate more potatoes and when some of the varieties used contained more of these alkaloids than the modern varieties there were occasional solanum-alkaloid poisonings. If even low-solanine potatoes are exposed to light and turn green, the green portion may develop enough toxic material to cause illness if eaten in sufficient quantity (Zettel, 1937).

The view that "natural" or "organic" substances are safe applies to the ones humans have learned through experience are safe for almost all persons, as commonly used But the examples given show that it does not apply to all natural substances to all the components of the natural substances we use as food. Moreover, the view does not apply to all people. Some persons are allergic to foods that can be eaten safely by others.

One more important point that must be clarified is the fact that where or how a specific chemical compound is formed is irrelevant as far as the properties and effects of the compound are concerned. Today, many of the simpler organic substances produced by living organisms can be synthesized in the laboratory by chemists. When the synthetic version of a naturally occurring organic chemical is produced in a laboratory or factory, the resulting chemical is identical to the one produced naturally by plants or animals. Thus, for example, vitamins are the same organic chemicals and have the same effects whether synthesized in a laboratory or by living organisms.

Chemicals in general and organic chemicals in particular, cannot be classified as safe or unsafe on

[6] Estimations by S. R. Aldrich based upon crop acreages, yields and livestock numbers.

the basis of their origin. Some organic chemicals that are synthesized by living organisms are extremely toxic to humans (e.g., botulinum toxin and aflatoxin B_1), and some are essentially inert in the human body (e.g. cellulose) Some organic chemicals that are synthesized in the laboratory (e.g., TCDD or dioxin[7]) are extremely toxic to humans, and some are essentially inert the human body (e.g., plastics).

A chemical becomes hazardous only when the degree of exposure is sufficient to cause toxic effects. Even the most highly toxic chemicals present no known hazard if the exposure is low enough. For example, parathion and carbofuran are highly toxic manmade chemical not known to be synthesized in nature, but they may be used with little hazard if they are properly handled. Probably everyone is exposed to minute quantities of naturally occurring aflatoxin B_1 and TCDD, but recognizable toxic effects appear only with far greater exposures. The thousands of chemicals that constitute the food supply are collectively beneficial the quantities normally ingested, but all would have detrimental effects if ingested individually in excessive quantities. For example, seven infants died in a Binghamton, New York, hospital when common table salt was added to their formula under the impression that it was sugar (Anonymous 1962, 1962a).

When highly toxic chemicals are used because of their useful properties, precautions must be taken to assure that human exposure does not exceed safe level. For example, the pesticides known as parathion and Furadan are highly toxic substances not known to occur in nature, but they may be used safely if handled according to the directions on the label.

An unreasonable fear of chemicals has developed in recent years and public alarm now easily generated at the mention of compounds that are unfamiliar or bear exotic names. To illustrate, if it were proposed that acetone, acetaldehyde, methylpropyl ketone, methyl isovalerianate, isoamyl isovalerianate, methanol, o-methylpropylbenzene or ß-phenylethylcaproate be added to fruit as a preservative or to enhance the flavor or aroma, a measure of public opposition could be expected, when in fact, all of these chemicals and many naturally n ripe strawberries (Vereschagin, 1974). Of course all could be harmful if ingested in excessi amounts. Acetone is sometimes used to remove varnish from furniture, and methanol is better known as wood alcohol, which, in sufficient dosages, produces blindness.

ISSUE NO. 3: SOURCES OF PLANT NUTRIENTS

The plant nutrients most often deficient in soils, and most often supplied in fertilizers, are nitrogen, phosphorus and potassium. One of the major differences between organic and conventional farming is the source of the nutrients used for crop growth. Most conventional farmers use commercial fertilizers that have been chemically processed, whereas organic farmers prefer to use "natural mineral fertilizers." Where nitrogen is concerned, organic farmers prefer to use leguminous crops to fix atmospheric nitrogen and to preserve this nitrogen for use by crops by recycling it in crop residues and animal manures.

Phosphorus

The natural mineral phosphorus fertilizer is phosphate rock (commonly called rock phosphate in agriculture), which is finely ground and mixed with the soil. Much rock phosphate was used as a fertilizer by conventional farmers in the United States at one time, but little is used at present.

Most of the rock phosphate that occurs in the United States has low solubility and low effectiveness source of phosphorus for plants. When rock phosphate is added to the soil, years are required for it to dissolve so the availability of the phosphorus can increase. For most rapid dissolution of rock phosphate, the soil must be strongly acid, a condition not conducive to good growth of the leguminous crops that are an integral part of organic farming.

In parts of the world, the rock phosphate deposits are much more soluble than those in the United States. Efforts now being made through the International Fertilizer Development Center at Muscle Shoals, Alabama, to develop the use of these deposits for direct application to soils as a source of phosphorus for plants

[7] TCDD is produced also when natural substances including wood and coal are burned, and it is of widespread occurrence in barely detectable traces in the environment (Chlorinated Dioxin Task Force, 1978).

Most of the fertilizer phosphorus used by conventional farmers is chemically processed in one way or another An increasing proportion of the phosphorus used in fertilizers is present as highly soluble compounds such as ammonium phosphates that contain nutrient elements other than phosphorus, are more concentrated and more economical to ship than is rock phosphate, and are immediately available to plants. The phosphorus in such fertilizers quickly reacts with the soil to form compounds of lower solubility, but the substances of intermediate solubility persist for more than year as source of phosphorus of gradually decreasing solubi ity and availability.

The origina treatment used to ncrease the solubility of the phosphorus in rock phosphate for use by plants was addition of fairly concentrated sulfuric acid The added sulfuri acid disappeared, being neutralized by the phosphate rock, and the product solid consisting mostly of monobasic calcium phosphate and calcium sulfate. The product was often called acid phosphate in the early years, but later the name superphosphate was adopted because of the unfavorable connotation of "acid."

The use of sulfuric acid in making superphosphate sometimes leads those opposed to use of commercial fertilizers to suggest that the sulfuric acid makes the soil acid when superphosphate is used as a fertilizer. There is some indirect truth i thi allegation. For example, agricultural soils would be acidified by adding superphosphate in large enough quanti ties to react with all the reactive substances the soil, but this is not a realistic situation, and the reaction would be due to the monobasic calcium phosphate, not the sulfuric acid that was responsible for its formation. In practice, where superphosphate is added in small quantities, the monobasic calcium phosphate it contains interacts in different ways with different kinds of soils. If superphosphate is added to an alkaline soil that contains free calcium carbonate, the monobasic calcium phosphate acts as an aci and interacts with calcium carbonate, decomposing it and releasing carbon dioxide gas. The usual amounts

of superphosphate added, however, would have no appreciable effect on the acidity of such a soil. On the other hand, if the usual amounts of superphosphate are added to a strongly acid soil, the monobasic calcium phosphate interacts as an alkal with clays and hydrous iron and aluminum oxides with the result that acidity is decreased. In most soils, addition of the usual amounts of superphosphate has no appreciable effect on the acidity one way or the other.

Potassium

The potassium used as a fertilizer in the United States is derived almost exclusively from salt beds produced from evaporation of bodies of water, mostly in earlier geologic time. The potassi salts in such deposits are soluble in water, and thus no special treatment is needed to make the potassium available to plants.

The potassium salts found in the salt beds are not pure, however, and it is uneconomic to transport the impurities along with the potassium salts for the long distances that separate the mines and most of the soils on which potassium is needed for crop production. For this reason, the potassium salts are usually purified at the site of mining by using water to remove the constituents not wanted.

Conventional farmers use the purified potassium salts, but organic farmers tend to prefer the potassi um salts as mined if they are available. The sodium salts that usually constitute most of the impurities are useful for certain crops such as beets if adequate potassium is not present, but if applied in large quantities they may have unfavorable effects on some soils and crops. There may also be problems due to minor impurities that are toxic. For example, some of the first potassium fertilizer produced from deposits in the United States had disastrous effects on crops because of boron toxicity. The purification had not been conducted n such a way as to reduce the borate content to harmless or beneficial levels.

Nitrogen

Until the early 1900s, nearly all the nitrogen present in harvested crops in the United States was derived from that released upon decomposition of the soil humus, either directly or after recycling through previous crops or animal manures. Small quantities of atmospheric nitrogen were converted to plant-available forms by lightning and certain soil microorganisms.

Later, inoculated leguminous crops (alfalfa, clover, lespedeza and others) were introduced specifically to replenish nitrogen supplies for succeeding crops. The bacteria in the root nodules on leguminous crops convert atmospheric nitrogen into organic forms, and much of this nitrogen passes from the nodules into the main part of the plant, where it supplies the nitrogen needs of the plant. When leguminous plants e plowed under, they enrich the soil with nitrogen and the microorganisms that decompose the residues then vert the nitrogen the organic substances supplied by the leguminous plants to ammonium and thence to nitrate, which may be used as inorganic nitrogen sources by the crop that follows.

A system of "rotation" farming, in which crops were grown in sequence with the crop demanding the most nitrogen following the legume, developed to take advantage of the nitrogen fixed by the legume. Crop rotations including legumes to supply nitrogen to the succeeding nonleguminous crops prevailed throughout much of the United States until the late 1940s and are still common on many livestock farms.

The primary schism between organic and conventional farmers, as far as nitrogen sources is concerned, developed following World War II, when synthetic nitrogen fertilizers first became available at relatively low prices. Conventional farmers then began using nitrogen fertilizers in increasing quantities. The results were profound changes in crop and livestock specialization by farms and by regions. For instance, farmers increased the acreage of corn and soybeans (high-return crops) and reduced the acreages of small grains, legume hay and green manure, making up the nitrogen deficiencies with synthetic nitrogen fertilizer. They also modified other production practices and greatly increased the yields of nearly all crops in all regions. This, in turn, increased the amount of nitrogen that was needed and could be efficiently utilized by crops.

In the following paragraphs, we shall assess the advantages and limitations of the various sources of nitrogen other than commercial fertilizers that are utilized in both conventional and organic farming. Then we shall discuss the pollution potential, which is one of the principal controversial aspects of commercial nitrogen fertilizers. The energy requirement for producing synthetic nitrogen fertilizers, another controversial issue, will be discussed with other energy-related matters under "Issue No. 5, Energy Requirements."

Nitrogen From Soil Organic Matter (Humus)

Humus contains nitrogen, phosphorus and sulfur in organic forms that are not available to plants. When the humus is decomposed by soil microorganisms, these nutrients are changed to inorganic forms that plants can absorb. Of these nutrients, nitrogen is first in quantity and generally first in importance to nonleguminous plants grown in soil that does not receive commercial ferti izer.

Under natural conditions before cropping began, the content of humus in most soils was relatively high, and annual additions of nitrogen in humus about equalled losses. When the pioneers cleared the land of its native vegetation and tilled the soil to grow food or feed crops, they upset this natural equilibrium. The humus then decomposed more rapidly than it was formed. The humus nitrogen was released in forms available to plants, and this nitrogen was the principal source used by crops.

Part of the nitrogen from crops fed to livestock was returned to the and through the manure. Return of manure provided a valuable means for reducing the rate of loss of humus from soi and for reducing the rate of depletion of nitrogen and other nutrients (Salter and Green, 1933; Salter and Schollenberger, 1939). ivestock farming was recognized as a soil-fertility-conserving system in comparison with systems in which the crops were sold as such. But since manure recycles only a portion of the nitrogen and other nutrients previously removed from the soil, soil fertility generally declined. Of course, large increases could occur on farms that imported large quantities of feed from other areas for livestock and poultry feeding operations.

Today most soils farmed in the United States have less than 50 percent of their native humus content. A new, much lower equilibri content of humus has been established in many soils. The main cause of the decrease in soil humus content has been tillage, which accelerates the loss of humus by both microbial decomposition and soil erosion. Removal of crops is another factor. Crop yields would have been decreasing

with the level of humus, had it been necessary to depend on humus decomposition to meet crop needs for nitrogen. As a result of development of alternative sources of nitrogen, however, the proportion of the nitrogen needs of crops met by decomposition of native soil humus has been decreasing.

Nitrogen From Animal Manure

Animal manure is an excellent source of nutrients for crops, but it must be carefully preserved and applied to realize its maximum benefits. It is a highly perishable commodity. The nitrogen and potassium are readily lost by leaching, and nitrogen is lost also by ammonia volatilization.

An estimated 175 million tons of animal manure (dry weight basis) are produced annually in the United States, 107 mi lion tons of which are dropped on the land by grazing animals. The remaining 68 million tons are produced by animals in confinement, and about 73 percent of that (50 million tons) is returned to the land (Miller et al., 1978). The potential nutrient value of the 50 million tons produced in confinement and applied back on the land is equivalent to that of about one-twelfth of the nitrogen one-fifth of the phosphorus and one-fifth of the potassium currently applied in commercial fertilizers in the United States.

The chances of increasing markedly the quantities of nitrogen supplied to crops in animal manures appear slim. According to a 1978 USDA report (Miller et al., 1978), the 63 percent loss of manure nitrogen through volatilization and leaching in storage, handling and after application could be reduced only to 45 percent. If achieved, this reduction in loss would raise the amount of nitrogen from collectible manure from about 9 to 12 percent of the amount currently supplied by fertilizer.

Animal wastes as voided contain 75 to 90 percent water. The energy and abor required to transport this dilute of plant nutrients limits the distance to which the wastes can be economically hauled for application. The energy required to manufacture, transport and apply plant nutrients in synthetic fertilizer is equivalent to that required to haul and spread an equal amount of plant nutrients in manure to a distance of about one mile (Heichel, 1976) Drying manure with supplemental heat or by exposure to ai (suited only to arid regions unless large losses of nutrients due to eaching by rainfall in humid regions are accepted) is economically feasible mainly for specialty products for gardens, lawns, bedding plant and pot culture.

Livestock manure can lead to some environmental problems not likely to be experienced with commercial ferti izer. Surface waters near large ivestock operations may absorb considerable amounts of ammonia that volatilize from the manure (Hutchinson and Viets, 1966). If manure is spread on frozen ground for disposal when feedlots or buildings are cleaned during the winter, surface runoff may be of water pollution.[8] Manure runoff contains organic matter that causes oxygen depletion in receiving waters. Pollution of shallow wells may result when manure accumulates in feedlots or when it applied to soi in excessive quantities to avoi the cost and inconvenience of transporting it to more distant areas where it could be used more effectively for crop production. The accumulation of salts may have detrimental effects on plants, particularly in dry regions where the soils already contain considerable amounts of soluble salts. Moreover, a greater proportion of the nitrogen in manure than in commercial fertilizer remains in the soil after crops are harvested and is subject to change to nitrate and loss in surface and groundwater during the winter and spring when no actively growing crop is present. And, of course, many people find the odor of freshly-spread manure objectionable. Most nuisance complaints about odor occur when manure is spread in warm weather.

Although manure does have some disadvantages, it is a valuable asset for soil improvement in both organic and conventional farming, not only as a source of nitrogen and other plant nutrients but also as an amendment to improve the tilth and water relations of the soil. The potential benefits justify continuing attention to practices that will conserve manure and utilize it effectively (Salter and Schollenberger, 1939; Hinish and Jordan, 1972; Pratt, 1971; Jordan, 1974, 1976).

Nitrogen From Leguminous Crops

Nitrogen is most commonly the limiting nutrient of first importance in cropped soils. Prior to the availabi ity of large amounts of fertilizer nitrogen at decreasing costs following World War II, most of the net input of nitrogen to soils in conventional farming resulted from growing leguminous crops. At that time, cropping patterns i nitrogen-deficient gions and, in fact, whole farming systems were buil around legumes as the principal nitrogen input to farms A mixed ivestock, grain-farming system, typical in many regions utilized the legumes as feed and returned part of the nitrogen to the soi in manure for use by other crops. Cash-crop farmers often grew a legume green-manure crop in smal grai and plowed it under to supply nitrogen for the following crop. The same is true today in organic farming.

When syntheti nitrogen fertil became generally available at low price many conventional farmers found it profitable to use them rather than legumes to supply needed itrogen. This substitution capability gave them more options selecting cropping patterns and farming systems The result was increase in the number of cash-grain farms and the disappearance of vestock from many farms Although livestock are til widely distributed, an ncreasing proportion is produced fewer but larger farms

For many farmers change in cropping patterns to ncrease the amount of farm-grown nitrogen results in fewer acres of the highest yielding or highest value crops. The loss in aggregate production because of a different mix of crop acreages is in addition to somewhat lower yields of each crop per acre.

Increasing farm-grown nitrogen under dryland and rrigation farming systems is of limited feasibility, as explained in succeeding section on economic impacts of organic farming

To utilize the additional legume forage most efficiently, the logical step is to increase livestock. Increasing the acreage of egume forage would of course reduce the amount of vegetables and/or cash grains on individual farms and also the aggregate production of these crops on present cropland acreage. A small shift would have small impact; but a large shift would have great impact. For example, a large shift to less grain and more livestock in the Corn

[8] Significant loss of nutrients can occur by surface runoff when commercial fertilizers are applied to frozen ground, but they are not often so applied.

Belt would mean less grain for transport to grain-deficient areas i the northeastern and Atlantic Coast states and less for world trade.

A further deterrent to substituting itrogen-producing legumes for higher value nonleguminous crops is the fact that land prices have ri seven-fold over the same period in which nitrogen costs have only doubled; hence, land productivity has become increasingly important. The short-run prediction is that the price of nitrogen fertilizer will remai relatively more favorable than the price of land. The longer term outlook cannot now be rel ably forecast.

Nitrogen From Sewage Sludge

The total amount of nitrogen contained in municipal sludge produced in the United States is about one-seventh that in animal manure (Miller et al., 1978). At present, approximately 23 percent of the municipal sewage sludge produced is applied to land, but very little to crop-producing land.

According to data published by Miller et al. (1978), available sludge could replace an estimated 69,000 tons of fertilizer nitrogen annually if an adjustment is made for losses and if 40 percent of the nitrogen available the first year. Since this amount is equivalent to less than one percent of the nitrogen presently supplied in commercial fertilizers, it is of little consequence to U.S. agriculture as a whole.

Using sewage sludge for producing food and feed raises some unresolved questions about the presence of heavy metals (cadmium, lead, copper, nickel) and other toxic substances and, hence, possible hazards for the food supply. Availability and transportation also must be considered (Walsh et al., 1976).

Nitrogen Source And Water Pollution

The nitrogen in some fertilizers is present partly or entirely as nitrate, but most of the fertilizer nitrogen applied in the United States is in other forms. Nitrate is an inorganic form of nitrogen that is a normal end-product of microbiological transformation of nitrogen added to soil in fertilizers and in nitrogen-containing organic substances, including plant materials, animal manures and sewage sludge. In both conventional and organic farming, plants absorb nitrate from soils and use it as a source of nitrogen for synthesizing proteins and other nitrogenous compounds. Soil microorganisms also absorb nitrate and change to organic nitrogenous substances if their numbers are increasing in response to addition of plant residues low in nitrogen.

Nitrate is soluble in water and is not adsorbed by soils. Consequently, it is readily removed from soils by water and may be moved downward into ground water or laterally into surface water. Excessive nitrate in ground waters may present a hazard of methemoglobinemia to infants whose formula is prepared using nigh-nitrate well water. Occasional problems have been reported with shallow farm wells that appear to have been contaminated by nitrate from adjacent feed lots Nitrate-contaminated water can easily be purified by distillation or passage through an anion-exchange resin column to prepare the small amounts of water used by infants.

The marked increase in usage of nitrogen fertilizer in the United States through the years (from 1.0 million tons of nitrogen in 1950 to 10.6 million tons in 1979) has nonetheless given rise to concern regarding the contamination of surface water and ground water with nitrate. Nitrogen fertilizer has been alleged to be the principal cause of the increase in nitrate content of some surface waters (Commoner, 1968; Kohl et al., 1971; Parker et al., 1974), the implication being that the nitrate present in these waters is the same nitrate added in the fertilizers or produced by soi microorganisms as they convert other forms of fertil er nitrogen to nitrate.

To the extent that increase in nitrate content of these waters has occurred recent years, nitrogen fertilizer may indeed be largely responsible in an indirect way because the principal additional primary input of nitrogen to agricultural soils in recent years has been fertilizer nitrogen. Little of the fertilizer nitrogen is lost directly by runoff because mos of the fertilizer is applied below the surface of the soi or is soon incorporated into the soil. Typically about 40 to 50 percent of the fertilizer nitrogen is taken up by the crop in the first year; the remainder distributed among carryover of inorganic forms of nitrogen, incorporation into soil organic matter, loss by leaching, and loss by change to gaseous forms Fertilizer nitrogen increases the productivity of soils for crops and livestock by increasing the quantities of nitrogen and other nutrients being cycled through them. Soil nitrate is normal stage in the cycle, and an increase in of nitrogen from the system as nitrate may occur whenever the supply of nitrogen is increased as a result of prior addition of fertilizer. These same statements could be made if the additional itrogen added animal manures produced from feed grown off the farm, in sewage sludge or legumes that fix nitrogen from the atmosphere. In other words the additional nitrate n water is a result of greater total supply of nitrogen and is largely independent of the source of nitrogen (Aldrich, 1972).

Nonetheless, some differences in loss of nitrate derived from the nitrogen in different sources may be anticipated, especially i the first year According to Allison (1965), "Past research has shown that the highest nitrogen recoveries are almost invariably observed following the addition of a readily available form of nitrogen to crop that can utilize it quickly. The portion of the nitrogen that i applied in slowly available form, and not used the first year, is subject to leaching during the colder months, if any is made available." Thus, the proportion of the added nitrogen that is lost as nitrate is likely to be less with commercial nitrogen fertil zer than with crop residues, legumes, manures and sewage sludge that supply an equivalent amount of nitrate because much of the nitrogen in the latter materials is lowly converted to nitrate and may be subject to oss during late fall, winter and early spring when no crop is present or when the crop is absorbing little nitrate.

Nitrogen applied to the soil as fertilizers up to the point of maximum net economic return results in only small to moderate increases in nitrate level in the subsoil (Bomke and Welch, 1972; Hensler and Attoe 1970; Smith, 1968; Broadbent and Carlton 1978; Olson et al., 1970). With greater applications however, nitrate increases rapidly in soil below the root zone. Therefore, both from an economic standpoint and to avoi excessive nitrate ground water or surface water, additions of fertilizer nitrogen should be tailored as nearly as feasible to the quantities that will produce the economic optimum yield.

The optimum amounts of nitrogen for individual fields in individual years, however, unfortunately cannot be predicted accurately at application time. It is impossible to know how much nitrogen will be

lost through leaching and transformation to gaseous forms because these processes are affected by rainfall, which cannot be accurately predicted. Moreover, the potential yield is unknown early in the season, and this is another important factor in determining the optimum application of fertilizer nitrogen.

In view of the uncertainty the farmer is faced with the fact that he cannot recover his loss n potential yield he applies too little nitrogen to permit his crops to take full advantage of favorabl growing season. If he applies too much nitrogen, he takes advantage of the potential yield in the year of fertilization, and he may also recoup part of his nitrogen investment that was not productive in the year of overfertilization through carryover of some of the nitrogen in the soil for the succeeding crop. Thus if nitrogen fertilizer is relatively expensive in terms of the increases in production it generates, the uncertainty encourages the farmer to fertilize for the less favorable years and to underfertilize for the good years. If nitrogen fertilizer is inexpensive, he is encouraged to fertilize for the good years and to overfertilize for the years that turn out to be less favorable. Although the price of nitrogen fertilizer is now increasing, the price in recent years has been low enough that the traditional economic restraints to fertilization have decreased, and evidence of overuse of nitrogen fertilizer in certain instances has developed (Pratt et al., 1972; Adriano et al., 1972; Carter et al., 1976; Ludwick et al., 1976), as might be expected.

Despite the imponderables, improvements in practice can be made that will alleviate what to some is "the nitrate problem," but to the farmer is a matter of the logistics of increasing the efficiency of the nitrogen he applies as fertilizer. Methods have already been developed for assessing the of nitrogen relative to crop needs (Pierre et al 1977; Stanford, 1973), and researchers in several states west of the Mississippi River (where loss of nitrogen by leaching is of less importance than it is in high-rainfall areas) are starting work to improve their recommendations by measuring the nitrate carried over in the soil from the previous crop (Dahnke and Vasey, 1973). Additional information is available on the importance of timing nitrogen applications (Olson et al., 1964). Further development and implementation of improvements in practice will be encouraged if, in the years ahead, the relative increase in cost of nitrogen fertilizer exceeds the relative increase in the returns farmers receive from their crops.

ISSUE NO. 4: CHEMICAL VS. NONCHEMICAL MEANS OF PEST CONTROL

Many of the cultural and management practices used today in food production stem from attempts to reduce crop losses from weeds, insects, nematodes and diseases. Tillage, crop rotation, selection of resistant crop varieties and hand labor are employed by both organic and conventional farmers to control or avoid pests The two groups differ however, in the of synthetic pesticides.

This section briefly surveys the development of present pest control methods, the importance of pest control in producing fruit, vegetable and field crops, the comparative effectiveness of chemical vs. nonchemical control methods, and the potential of "integrated pest management."

Pesticide Development And Use

Prior to the 1900s, crops were largely produced without use of syntheti chemicals for pest control. During these early days, weed control, based on human and animal toil was sometimes so inadequate that the crop was lost. Growers had little means to prevent crop losses to pests other than weeds and losses were extensive in many years. dramati example was the potato late blight disease outbreak of 1843 and 844 in Ireland which destroyed the potato crop and caused widespread famine.

Probably the first synthetic "pesticide" was a combination of two inorganic compounds, copper sulfate and calcium hydroxide, called Bordeaux mixture. It was widely used as fungicide before 1880 and is still used today.

Awareness of the great potential for reducing losses to pests with pesticides developed in the early 1900s, and many chemicals were tried by agricultural scientists and nnovative farmers. A few came into commercial use However the major stimulus to pesticide development and use came with the discovery of DDT for insect control and 2,4-D for weed control. Farmers recognized the great value of these chemicals for controlling pests, and within a few years millions of acres of cropland were being treated. Concurrently, the chemical industry started an intensive search for pest control chemicals, and this resulted in nu- discoveries and the widespread use of pest control chemicals by farmers and others throughout the United States.

Chemical applications, both in the field and on harvested crops prior to shipping or storing, allow large quantities of fresh fruits and vegetables to be made available for purchase throughout the United States mos months of the year. Pesticide use on field crops (corn, soybean smal grains, cotton, etc.) similarly has provided effective, low-cost pest control.

Today, the American consumer expects plentiful supplies of unblemished, insect- and disease-free agricultural products. In fact, there are government regulations that prohibit pest-infested or blemished products market channels and retail outlets. One example the U.S. Food and Drug Administration's "defect action level," which imit the amount of insect parts in processed foods (Pimentel et al., 1977).

Weed Control

The importance of weed control for successful fruit, vegetable and field crop production undisputed. Weeds compete with crops for water, plant trients and light; often interfere with harvesting and increase labor and equipment costs. They may create a favorable environment for insects and diseases If not controlled, they lower crop yield and in some cases, crop quality (e.g., wild onion in wheat) Organic farmers affirm that weed control s thei most serious problem (Lukens, 1978; Wernick and Lockeretz, 1977; Goldstein, 1978), as indeed it is for most conventional farmers.

On a world-wide basis, weed control, mainly without the use of herbicides, requires more time than any other single human task (Holm, 1975). For example, Nigerian village farmers spend 56 to 74 percent of their working hours weeding their crops. Where subsistence farming is practiced, farm size is often limited to the area on which the farm family is able to control weeds by hand or with animal-drawn tools.

Attempts to develop biological control for weeds have met with imited success. Of a total of 52 controls reported n 14 countries for individual species of weeds by insects, control of the weed was complete in 9 instances, substantial in 17 and partial in 26 (Wiese and Chandler, 1979). Most water weeds can be controlled by the grass carp but there is some concern that this fish woul so denude waters of vegetation that the habitat for waterfowl and native fish would be impaired (Shireman, 979

In U.S. agriculture both organic and conventional farmers management practices other than herbicide application to control weeds The practices usually include preparation of a seedbed free of growing weeds; fertilization and iming to give the crop compe tive advantage use of high quality seed of an adapted variety, use of optimum planting date, seeding rate and plant spacing; and tillage or cultivation after planting when feasible

Conventional farmers make extensive use of herbicides for weed control. Use of appropriate herbicides results in substantial yield increases because (1) they control weeds within the row where they would otherwise escape cultivati ; (2) they kill weeds ly in the season when crop plants are too sma to be competitive and when soils are sometimes too wet for cultivation; (3) used judiciously they may gradually reduce the number of weed seeds the soi so that less labor, energy and herbicides re needed i the future; and (4) they reduce the number of ti lage and cultivation operations needed, which essens the degree of soil compaction and leaves more crop residue on the soil surface to control loss of soil and water. In fact, some forms of "conservation ti lage," with its goal of reduced erosion and sediment pollution, would not be feasible without herbicides.

Infestations by certain weed species, however, can increase from long-term use of a single herbicide to which the weeds are resistant. For example, continua use of herbicide that controls broadleaf weeds eads to buildup of grasses and vice versa. Therefore, conventional farmers must carefully select the herbicide or combination of herbicides that will provide the most help in controlling their specific weed problems.

On the whole, increased production costs and reduced yield and quality of produce result when fruits and vegetables are produced without use of herbicides. In the production of small fruit, intensive weed control prior to planting is a necessity if perennial weeds are present. Conventional farmers generally control these weeds quickly with herbicides, whereas organic farmers must use repeated clean ti lage, which prevents crop production on the and for one or two seasons prior to planting the small fruit. Once these weeds are controlled, a good mulching system plus limted ti lage may provide adequate weed control in brambles and blueberries. The organic mulches needed to protect strawberry crowns from heaving injury (due to freezing and thawing of the soil), however, may hinder weed control or bring in new weed seeds.

For small-seeded vegetables, such as carrots, lettuce and onions, adequate weed control is usually not possible by mechanical cultivation alone. Without herbicides, intensive hand weeding within the row is a necessity. Often an hour or more is required to weed 100 to 200 feet of row. The excessive time requirement makes hand weeding economically prohibitive. Hand weeding often results in crop damage. In growing these crops, therefore, the conventional farmer who uses herbicides has a great advantage over the organic farmer who does not.

For large-seeded and transplanted vegetables, manual, mechanical and mulch systems for weed control are possible alternatives to herbicides, but these methods are significantly more expensive (e.g., $30 to $150 per acre for hand weeding vs. $5 to $35 per acre when herbicides are used).

Imaginative research in the areas of weed physiology and weed ecosystems may produce future lternatives to annual applications of herbicides. For example growth regulators could be developed that would cause all weed seeds in the top 4 to 6 inches of soil to germinate, crops could then be kept free of weeds with only little tillage or with a small amount of herbicide. This principle is already being utilized in witchweed control (Langston et al., 1979).

Insect Control

Insecticides are usually used to control insect infestations that have already developed, although they are sometimes applied preventive measure because an insect present or because an infestation is likely to occur. The desirable practice is to make applications only when the infestations are sufficient to cause significant economic loss if they are not checked.

It is sometimes argued that if the use of insecticides were prohibited, the populations of beneficial and pestiferous insects would come into balance within the agro-ecosystem thus negating the need for insecticides to protect crops from insect pests. This rgument is refuted by the fact that insect problems were prevalent long before the advent of modern insecticides. In instances, however insecticide has destroyed natural enemies, with the result that the severity of infestations by previously minor pests such as spider mites has increased.

Insect problems today natural ecosystems; hence they are not unique to agriculture. Nonetheless, the problems intensified in agriculture. One reason is that the large areas devoted to single crop in agriculture provide concentrated source of food for insect pests specific to that crop, with decreased possibility of control by insects that might be associated with the other species that usually occur in a natural ecological setting Another reason is that the genetic qualities that produce desirable agricultural plants may not carry with them desirable resistance to insects. The problems are further ntensified if susceptibl crop is grown frequently or continuously on the sa land.

The potentia for biological control of insect pests varies. Some insect pests have several potent natural enemies, others very few. Many nsects such as the European borer that became serious pests were introduced nto the United States and thrived here where thei natural enemies were not present. Most predators and parasites are found in the native area of the host where they have coexisted with the host population for a long time before an important regulating relationship developed (U.S. Department of

Agriculture, 1978). Even when predators and parasites are present, natural pest regulation is often erratic. When heavy infestations develop rapidly, insect pests can cause extensive damage before predator or parasite populations increase to levels adequate for control.

Mass propagation and release of natural enemies to control insect pests has sometimes been successful, and appropriate management of crop ecosystems also has been successful in controlling insect problems in some crops (e.g., crop rotation to reduce rootworms). The greatest success with biological control however, has been achieved through research to incorporate genetic resistance in crops to certain insects.

There has been much publicity in the popular press suggesting that continued use of insecticides will result in development of "superpests" resistant to all insecticides. This notion indicates a misunderstanding of the nature of resistance and how it comes about. The individuals within the population of a given insect will differ in susceptibility to a given insecticide, and a few may be resistant to the dosages applied. When competition from the susceptible individuals is eliminated, the few resistant individuals may multiply and fill the ecological niche occupied by the original strain that may have consisted mostly of susceptible individuals. However, this "new" strain, while resistant to the previous specific chemical or mode of action, is likely to be as susceptible as the original population to other kinds of insecticides or other methods of control (Benson, 1971). (There is some disagreement over the extent to which the development of resistance to one insecticide carries resistance to another.)

Disease Control

One of the crowning accomplishments of plant breeders and plant pathologists has been the control of many plant diseases through breeding for genetic resistance. Commercial varieties of nearly all important fruit, vegetable and field crops are now resistant to some diseases, thus greatly reducing the need for chemical control. Many opportunities exist for further improvement in plant disease control through breeding for genetic resistance. This biological approach is immediately useful in all systems of food production.

Foliar sprays are seldom used for disease control in major field crops like corn, soybeans, wheat, oats, barley, sorghum, alfalfa and cotton. Unfortunately, some frui and vegetable crops (e.g., peaches, pears, apples, grapes, brambles strawberries, potatoes, onions tomatoes, muskmelons eggplant, celery and squash) are subject to diseases for which there is no feasible control except foliar fungicidal sprays In some cases (especially muskmelon squash and cucumber) insecticides are needed to control disease-carrying insects. Organic farmers thus find it difficult to obtain high yields of these species where the diseases are a problem.

The economic threshold concept that has been found useful with insect control is not generally applicable to plant diseases. As a specific example, with the late blight disease of potatoes, caused by *Phytophthora infestans*, the spray program must be applied before any late blight appears because the fungus reproduces rapidly, and the disease is so devastating that available fungicides are not capable of arresting it, once infection has occurred.

Conventional farmers treat seed with a small amount of an appropriate fungicide, which improves seedling establishment, especially in years when the soil is cool and wet at planting time. Presently, there is no effective substitute for seed treatment. The compounds now used for seed treatment in the United States have relatively low toxicity to humans and other animals and are considered safe when used according to the label directions

Nematode Control

Nematodes are now recognized as pests of major importance in reducing crop yields, but the magnitude of the problem they create is not yet well defined in some instances. Monetary loss per acre due to nematodes is probably greater on vegetables and citrus than on field crops like corn, wheat and soybeans. But because of larger acreages, total monetary losses may be greater in field crops.

Crop rotation, plant varietal resistance (tomato and sweet potato), and suitable tillage have greatly reduced the need for commercial nematicides in some instances but not in others. Thus, in the short run at least, nematicides will continue to be valuable, even essential on some commercial farms.

Organic matter additions to the soil may affect nematode problems in one of two ways. (1) Adding nematode-infested plant residues will worsen the problem. (2) Adding noninfested residues, such as hay, bark, cottonseed meal and animal manure, will likely favor the growth of organisms antagonistic to nematodes, thus reducing the problem.

In North America, to date, most experiments on the effect of additions of organic materials on nematodes have been conducted in greenhouses, laboratories or small field plots. Generally, the work has been encouraging enough to continue, and it has reached the point at which more field scale studies are needed. One practical problem with this approach to nematode control however, is that the quantity of organic amendments that would be required for effective nematode control often exceeds the supply.

Many nematicides are halogenated hydrocarbons, carbamates and organic phosphates. Their misuse can be detrimental to humans, wildlife and the environment in general. But their proper use has often resulted in increased yields that could not have been achieved by any alternative method.

Current Role Of Chemicals In Harvesting, Storing And Marketing

Use Of Desiccants And Defoliants

Chemical sprays are sometimes used in commercial agriculture to hasten the dropping of leaves from the crops to be harvested or from weeds that interfere with harvesting. For example, in areas with growing season longer than 230 freeze-free days, the practice of using desiccants and defoliants provides three benefits in cotton harvesting: (1) it allows harvest at the optimal time for yield and quality, rather than being delayed until the first freeze defoliates the plants; (2) it is a basic component of integrated pest management, in that early harvesting reduces habitat for overwintering boll weevils and other cotton pests; and (3) it allows machine stripping, which is much less expensive than machine picking. Use of desiccants and defoliants is of less value in the High Plains area of Texas, which now grows nearly one-third of the cotton, because this has major insect problem and normally has natural defoliation.

Effects Of Pesticide Use On Produce Availability And Marketing

Once damaged by pests, many fruits and vegetables soon decay, and the rots quickly spread to sound produce. Even lightly damaged fruits and vegetables have short torage life. Thus, without effective pest control chemicals, not only would present quantities and qual ty of produce be reduced, but also shipment from one section of the country to another and year-around availability would be unfeasible. Produce that has not been treated for insects and diseases is not acceptabl for import in some countries.

A reduction the use of pesticides that assure storage quality would lead to greater reliance on locally grown fruits and vegetables available only seasonally, and on canned and frozen products, which have relatively high energy costs.

To some extent conventional growers must meet different standards for product appearance in the marketplace than do organic growers. The supermarket shopper desires--and gets--fruits and vegetables that are attractive and free from blemishes. Most fresh produce is traded in the wholesale market on the basis of grades which specify si and tolerable imits of blemishes according to government tandards. This promotes orderly buying and selling without the purchaser having to inspect each lot. These standards are also enforced to prevent losses during shipping, handling and toring (Some standards such as the color of oranges are cosmetic only and could be eliminated over time [Goldstein, 978]

In contrast the produce from rganic growers is often sold at relatively high prices to persons who are willing to tolerate imperfections for assurances that pesticides, additives and commercial fertilizers have not been used. Analyses of products collected in surveys however, have not demonstrated that the faith of consumers in the claims is well placed. In a survey of ten food items in the State of Washington while DDT was still being used as an insecticide, the DDT content of the tems purchased "health food" store was about the same as that of the comparable items purchased in a conventional store (Durham et al., 1965). In a more recent Florida survey (Appledorf et al., 1973) of 24 "health foods" and equivalent products produced by conventional methods, no pesticide residues were detected in either class of foods in excess of 0.01 part per million (the lower limit of sensitivity), but polychlorinated biphenyls were detected in seven samples of the health foods and three samples of the foods produced by conventional methods. In New York survey (State of New York, 1972), 17 of 55 food products (31 percent) sold as having been produced by organic methods were found to contain trace quantities of pesticide residues, whereas approximately 20 percent of the 2000 samples of conventional foods analyzed per year were found to contain traces of pesticide residues. Tests on organic lettuce in California (Naman, 1979) showed traces of pesticide residues.

Although the source of the residues found in these surveys not known, the implication is that the organic label is sometimes used as ruse to obtain higher prices than could be obtained the conventiona market for products produced with the aid of pesticides. If the demand for organic foods increases sufficiently, regulatory controls will probably be developed to provide reasonable assurance that the foods sold under the organic label are fact produced without use of chemical technology and this will probably result in an increase in cost of these foods to consumers.

Tolerances for pesticide residues are established by the Environmental Protection Agency, and the Food and Drug Administrati responsible for monitoring food products for residues According to a study published in 1975 by the National Research Council (1975), the U.S. population was consuming about 40 milligrams of pesticide residues per person per year in the food supply, more than half of the consumption being persistent chlorinated hydrocarbons that are no longer in use. The aggregate acute toxi ity of these residues consumed in yea has been estimated to be about the equivalent of the acute toxicity of the aspirin one aspirin tablet or the caffeine in cup of coffee. Although the possibility is often voiced that the residues may have unfavorabl long-term effects that are not assessed by acute toxicity, the results of long-term studies that have been made to date do not substantiate this argument The issue of possible long-term risks versus current benefits from use of pestiides has not been satisfactorily resolved by the scientific data availabl

Future Of Pesticides For Fruits And Vegetables

Each pesticide have federal registration and approval for each crop on which it is to be used The requirements for registering new pesticides and for reregistering old pesticides extensi to fulfill, however, that most pesticides presently being developed are intended primarily for use on field crops that occupy large acreages and present a potential market great enough to permit the company to make a profi after covering the costs of discovery, development, production and regulatory clearances (Upchurch et al., 1977). many cases the cost to a company to acquire data necessary for government approval to sell a pesticide for use on a minor fruit or vegetable crop might never be regained through sale of the product.

Many of the fruits and vegetables consumed in American diets are grown on relatively small acreages and are heavily dependent on certain pesticides. Hence, the continuing trend toward increasing cost of pesticide registration jeopardizes the future of pesticides for minor crops, including most temperate-climate and tropical fruits and vegetables. Moreover, the smaller the number of pesticide products available for use on given crop, the greater is the probability that the pests will develop resistance to them. Increasingly imited pesticide availability for minor crops will resul in fewer and more expensive fruits and vegetables of lower quality in the marketplace.

Integrated Pest Management — A Promising Approach

The Concept And Its Application

In recent years agricultural researchers have assigned an increasing portion of their efforts to alternative pest control practices involving reduced phasis on pesticides. The term "integrated pest management" (IPM) (Metcalf and Luckmann 1975; Smith, 1978; Goldstein, 1978) has been developed to describe many-faceted approach to achieving the best combination of available methods to control the various pests under the different conditions which the pests are of significance. The general IPM approach is to integrate proven cultural pest management principles and techniques (including genetic resistance in plants, modified cropping sequences, appropriate tillage, sanitation and field scouting to determine the magnitude of the problem) with timely use, if necessary, of an appropriate pesticide applied at the lowest feasible rate and at the weakest or most critical stage in the life of the pest. While IPM does not imply the com-

plete absence of pesticides, it does seek to employ alternative approaches, utilizing pesticides only when necessary and often at reduced rates.

The overall modification of agricultural practices thus far accomplished by introduction of IPM techniques has not been great because of limited availability. The potential for IPM lies mostly in the future. Development of IPM systems that are effective and appropriate for the multitude of combinations of crops and conditions that exist in practice will be a major research undertaking. Much additional knowledge about pest life cycles and greater understanding of the relationships of pests to other organisms including the crops they attack will be needed. Needed also is information on the economics of pest attack or pest infestation and the economi of vari pest control strategies. To date, the IPM concept has been developed mainly in connection with insect pests.

The trend toward IPM for pest control reverses the trend toward use of syntheti pesticides that began with the adoption of DDT and 2,4-D. In this regard, therefore, conventional farming may be said to be retreating from the extens ve use of pesticide chemicals in the direction of organic farming from which it departed in the 1940s.

In any subject with the emotional implications that pesticides have the minds of many people, there are bound to be controversies and misunderstandings, and this is true also with IPM. One of the misunderstandings that has developed in the minds of some is that practical, cost-effective IPM techniques are already available for pests in general and that the techniques need only implementation. Another misunderstanding is that pests can be controlled by increasing crop diversity and, thereby, reducing the concentration of crops in a geographic region, on a farm or in a field. At best, this belief is only partially true (National Research Council, 1975). For example, rotating crops increases the severity of infestations with six of the ten most serious corn insects in the Corn Belt, has no effect with two and decreases the severity of infestations with two (Metcalf and Luckmann, 1975). The populations of northern and western corn rootworms currently the most serious corn insects, are reduced by crop rotation. Although this is one of several factors that may be involved in the decision of conventional Midwest farmers to grow soybeans instead of corn on of their fields the organic farmers who use only thi nonchemical control of rootworms do so at the expense of part of their acreage of corn, the principal income crop in the Midwest. In the case of weed problems, some are ntensified by monocropping, and others by rotating crops. The best long-term weed control is obtained by combining crop rotation, tillage and use of appropriate herbicides.

Promising Additions To The IPM Approach

Alternative pest control strategies that appear to have promise and have already been developed to the point of some field use include a broad spectrum of biological approaches:

--Developing genetic strains of crops resistant to or tolerant of pest attacks.

--Introducing attractants such as sex hormones (pheromones) in insect traps.

--Utilizing juvenile hormones which interrupt the normal development sequence from young to mature insects.

--Developing insect sterilization strategies.

--Introducing predaceous and parasitic insects, pathogenic fungi and diseases.

--Using weed seed germination stimulants.

New technologies which increase pesticide effectiveness on target species while reducing nontarget impacts include the following:

--Using electrostatically charged sprays which increase retention of the pesticide on vegetation.

--Using soil-applied systemic chemicals in which the pesticide is taken up by plant roots and ncorporated nto the vegetation.

--Increasing the efficiency of granular pesticides at the action site.

--Applying pesticides directly on target weeds with roller or wiper applicators in lieu of sprays, granules or dusts.

--Reducing the proportion of very small droplets to reduce spray drift during ground or aerial application.

--Adjusting the pesticide application rate and spray volume to canopy density.

--Catching and recycling the pesticide solution that is not deposited on the target plants.

Regulatory Activity And IPM Development

Concern for publi health and the environment has resulted in expanded government regulatory activity during the past decade. Regulatory agencies have greatly increased safety testing requirements in their efforts to reduce the risks in pesticide use. Each proposed use of a pesticide must now be officially approved. These requirements have increased both the costs of pesticide development and the length of time between discovery and marketing of the products. According to information supplied by the National Agricultural Chemicals Association, the average cost of bringing a pesticide to market for the years 1974 through 1978 was $25 million ($53 million in 1978), and the time from discovery to market years. The time required from submission of the data to approval of the product by the Environmental Protection Agency averaged 21 months (32 months in 1978). These regulatory inhibitions apply to "second generation" pesticides that generally provide control for only a single pest species as well as to broad-spectrum pesticides (Tucker, 1978)

The high costs have reduced the numbers of pesticides registered per year. They have encouraged manufacturers to emphasize broad-spectrum pesticides that will have a wide market and to avoid specific pesticides that would have a limited market. These trends inhibi the development of IPM programs in two important ways: (1) the adaptabi ity to fit different circumstances is decreased, and (2) specific pesticides are not available to control specific pests without concurrently controlling other organisms, some of which might otherwise provide part of the control of these specific pests or others

The regulatory quality standards that are considered desirable for producing fruits and vegetables that are free of pests and blemishes also inhibit the

development of IPM systems. Truck loads of apples, for example, may be rejected and returned to growers on the basis of evidence of the presence of apple maggot in only a small proportion of the apples. Under such circumstances, growers have little incentive to use reduced rates of pesticide application or to use alternative methods of pest control that would result in less certain and less complete control.

ISSUE NO. 5: ENERGY REQUIREMENTS

As energy became a national issue, so also it became a basis for debate in conventional versus organic farming. Organic farming is presented as the more energy-conservative of the two systems. As Rodale (1973) put it,

> Highly mechanized and chemicalized farming requires much larger energy inputs per calorie of yield than does primitive farming. For example, the oriental rice farmer gets 50 calories back for every calorie he expends in personal energy. (Almost everything is done by hand.) Farmers using large machines need many calories in fossil fuel for each food calorie they produce--exactly the reverse situation.... Can people be encouraged to adopt lifestyles that are not wasteful of resources and energy, and that simplify the problems of food production and distribution? Will more people be willing to accept the physically demanding (though extremely productive in an energy sense) work that small-scale farming is?

In this quotation, Rodale classes mechanization with agricultural chemicals as something to avoid. On the other hand, as an agricultural engineer (Splinter, 1979) put it,

> From a strictly engineering point, man and animal are not efficient sources of power, especially in the tropics. If a man or an animal is performing work at 0.1 or 1 hp respectively, and since muscular work is about 20% efficient, the man or the animal must dissipate 0.4 or 4 hp in heat energy respectively. Under high temperature-high humidity conditions the capability to dissipate heat is severely restricted, potentially leading to a heat stroke or forcing work at a lower rate.
>
> Even under temperate conditions muscular work is not efficient. In studies reported by F. B. Morrison in his text on "Feeds and Feeding," you will find that the field work efficiency of a horse is from 20-25%, respectably comparable to a gasoline engine However, since one cannot turn his ignition off the horse continues to burn hay and oats all night long, bringing his daily work efficiency to about 9% and since he is not worked 365 days of the year, his annual work efficiency is only 2-3%.
>
> A. Makhijani, in his book "Energy and Agriculture in the Third World" found that the energy investment in producing a ton of rice in India, where 85 to 90% of the total energy input was human labor (including animal feed, human food, dung fuel, etc.) was 19×10^6 Btu while in Japan, where production almost totally mechanized, the energy investment was 6.2×10^6 Btu/ton.
>
> Therefore, it must be forcefully argued that man and animals are inefficient sources of power and that relegating mankind to the status of a work animal is not a socially acceptable goal

A simple and satisfactory analysis of energy utilization in conventional vs. organic farming has not yet been made, one reason being the diversity of both. Hence in this report we shall endeavor to provide a basis for understanding by explaining initially the evolution of conventional agriculture in terms of energy utilization and economics. Next we shall review briefly the energy aspects of agricultural chemicals because the clearest distinction between conventional and organic farming can be made in use of agricultural chemicals. Then shal review the comparisons that have been made of energy utilization in conventional and organic farming. And finally we shall consider energy for the future.

Evolution Of Energy Use In Agriculture

Solar energy makes plants grow, but humans must supply additional energy to direct the process to supply their needs for food, fiber and shelter. The capacity of humans to perform the hard physical work required in agricultural production is limited. Splinter rated it at 0.1 horsepower. Thus, the amount of food that can be produced by one person who must depend his own energy to do it is relatively smal If most or all of the food is to be produced this way, a large proportion of the population mus be engaged in food production. In years past, this is the way it was. In 1790, for example, 90 percent of the U.S. labor force occupied in agricultural production (now the figure is less than 4 percent).

In the United States, agriculture has always been a competitive enterprise in which the generally low income (as well as the heavy, energy-demanding nature of the work) has encouraged the development of means to make human resources more productive. The first step in the process was shifting much of the burden to domestic animals. Now machines have displaced domestic animals, and other inputs including fertilizers, pesticides and feed additives are used to increase the productivity still further.

All these inputs require energy. Human and animal labor are based on energy derived from food: part of the output of the system is consumed as overhead in producing the surplus amount that can be used by persons other than the producers themselves. An appreciation for the magnitude of the overhead may be obtained from a publication by Gavett (1975). He calculated that to produce the crops grown in 1974 by the technology of 1918, before the widespread use of the tractor, would require 61 million horses and mules. To feed them would require 180 million acres of cropland (almost half of the U.S. cropland now in cultivation). Moreover, performing the additional hand labor needed would require approximately one-third of the total U.S. labor force.

The continuing pressure to develop a system of agricultural production that makes more efficient use of human resources than one based on human physical labor may be inferred from the fact that in 1976 it

cost $26.50 to employ a farm worker for a 10-hour day, whereas work equivalent to that performed by a healthy, vigorous man who applied himself continuously for 10 hours could be performed by electrical energy costing only cents.

Electricity and the gasoline and other fuels used to power farm machines are derived almost entirely from petroleum, natural gas coal--the so-called fossil fuels. The comparative cost of human energy derived from food and of electrical energy derived from fossil fuel brings to the fore the question of economics, which is of basic concern in current decision-making. As long as fossil fuels and other energy sources can be utilized more economically than human labor, individual producers will be motivated to use them. The practical issue, therefore, is not that of calories (which is the basis often argued), but of dollars to obtain the energy used in agricultural production and of dollars that can be obtained for the agricultural products produced. If costs of nonfood, nonfeed sources of energy become high enough, the economics of the situation will force conventional farming in the direction of the more primitive agriculture from which it has evolved. Much commercial organic farming will be similarly affected

Energy For Fertilizers

Fertilizers accounted for an estimated 33 percent of the total energy input in crop production in the United States in 1974 (U.S. Department of Agriculture, 1976). Mos of the energy consumed in fertilizer production is used in the manufacture of nitrogen fertilizers in which natural gas is used not for its energy but as a source of hydrogen gas for making ammonia. (The Tennessee Valley Authority is now completing a demonstration plant for producing hydrogen from coal. Ammonia is a nitrogenous compound that is used as a ferti izer either directly or after conversion into other nitrogenous compounds.

Crops vary in nutrient requirements because of differences including yield potential and the ability of legumes to obtain nitrogen from the air. Corn is a nonlegume with a high yield potential, and it has a high fertilizer energy requirement. Legumes such as soybeans and alfalfa, however, have a much lower fertilizer energy requirement because they fix atmospheric nitrogen and do not require supplemental fertilizer nitrogen. As may be inferred from the data in Table 2, considerably less fertilizer-related energy is consumed in organic farming without nitrogen fertilizer than in conventional farming.

On the other hand, the use of nitrogen fertilizer lone is credited with providing one-third the productive capacity of crops in the United States (U.S. Department of Agriculture, 1973). And, according to estimates by Swanson, Taylor and Van Blokland (1978), limiting the application of nitrogenous fertilizer to 50 pounds of nitrogen per acre would result in a value loss to consumers (consumers' surplus) of $3.3 billion per year due to the lower crop yields and higher prices. The value gain to producers (producers' surplus) for the same reasons would be $2.0 billion.

There evidently arguments on both sides of the controversy. The energy sta istics favor organic farming. In practical agriculture, however, the decision turns on the cost of nitrogen fertilizer in relation to the selling price of the products it produces. The energy requirement is one of the factors in the cost of nitrogen fertilizer and in the cost of producing nitrogen-fertilized crops. If nitrogen fertilizer were free, the economic advantage to individual producers would be strongly in favor of using it generously. If nitrogen fertilizer were relatively expensive, as it was prior to World War II, the use would be sharply curtailed, and many conventional farmers would find it economically expedient to become "organic" in the sense of substituting legume nitrogen for fertilizer nitrogen.

Plowing a leguminous crop into the soil provides the maximum amount of nitrogen for the succeeding crops, but the nitrogen is expensive because of oss of production of other crops during the time the leguminous crop i grown. This procedure, therefore, is not often used unless the legume can be grown during the time of the year when the "cash" crops such as cotton and corn cannot be grown.

In practice, it is not always feasible to make a small shift in the balance of nitrogen supplied by nitrogen fertilizers and legumes The basic reasons are that (1) the eguminous forage crops that are the mos valuable sources of nitrogen have imited salability and (2) farmers derive more current ncome from cash crops than from selling the leguminous forage crops. The economics of using legumes as a source of nitrogen would thus encourage farmers to modify their

Table 2. Energy consumed in production, transportation and application of fertilizers in amounts sufficient to maintain the fertility of the soil (Graffis et al., 1977; Davis and Blouin, 1977; Hoeft and Siemens, (1975)

	Energy required, kilocalories per acre			
Nutrient	Corn, 120 bu/acre	Wheat, 40 bu/acre	Soybeans 50 bu/acre	Alfalfa 5 tons/acre
Nitrogen	875,000	357,000	0	0
Phosphorus	77,565	34,500	60,300	86,200
Potassium	32,175	13,000	59,750	387,300
Total	984,740	405,300	120,050	373,500

farming enterprise to include livestock to consume the legume hay. Livestock farming and cash-grain farming are different ways of life, and farmers tend to choose one or the other.

Energy For Pesticides

About 5 percent of the energy used in agriculture goes into the production of pesticides. A small additional amount goes into pesticide application. The total amount of energy used in producing and applying pesticides is equivalent to less than 0.2 percent of the total energy used in the United States and to about 15 percent as much energy as is used in producing and applying fertilizers (U.S. Department of Agriculture, 1976).

The input-output energy relationships involving pesticides in crop production may be illustrated by the data in Table 3, derived from six experiments on use of herbicide for weed control in Minnesota. The data show that the energy input for controlling weeds was greatest with cultivation, less with herbicide, and least with hand labor. The net profit in energy was greatest where weeds were controlled by hand labor, less where they were controlled by a herbicide and least where they were controlled by mechanical cultivation. The net profit in terms of energy was great with all methods, however, reflecting the great importance of weed control.

The energy accounting in Table 3 is of theoretical interest, but in practice agricultural products are not bought and sold on the basis of their energy content, and decisions on agricultural inputs are not based on their relative energy consumption, although energy may be a factor in both. Economics is the deciding factor. The method of weed control that is most profitable economically thus may differ from the one that is most profitable energetically. The distinction between the two bases for calculating profitability may be illustrated by comparing the energy data in Table 3 with the economic data in Table 4. Hand labor, which was the best method of weed control from the energy standpoint, was a disaster from the economic standpoint. At 1976 prices for corn and farm labor, a farmer using hand labor to produce 92 bushels of corn per acre would have lost $65.90 per acre on the operation. He would have been better off to use no weed control at all and to accept a yield of only 54 bushels per acre.

Table 3. Energy relationships in weed control in six experiments on corn in Minnesota (Nalewaja, 1974)

Method of controlling weeds[a]	Energy input for controlling weeds, kilocalories per acre	Yield of corn grain per acre		Net profit due to weed control, kilocalories per acre
		Bushels	Kilocalories	
None	0	54	5,443,200	-
Cultivation	56,005	81	8,164,800	2,665,595
Herbicide	37,920	90	9,072,000	3,590,880
Hand labor	32,655	92	9,273,600	3,797,745

[a] The land was plowed, disked and prepared for planting of corn in the conventional manner.

Table 4. Economic relationships in weed control in six experiments on corn in Minnesota (Nalewaja, 1974)

Method of controlling weeds[a]	Costs per acre at 1976 prices			Value of crop per acre at 1976 prices	Net profit per acre due to weed control
	Fuel, machinery and herbicide	Labor	Total		
None	$0	$0	$0	$132.30	-
Cultivation	3.43	1.51	4.92	198.45	$61.23
Herbicide	9.58	0.13	9.71	220.50	78.49
Hand labor	0	159.00	159.00	225.40	-65.90

[a] To produce the data in this table, dollar values for 1976 were added by the author.

The profit derived from controlling weeds by cultivation and herbicide explains why these methods are acceptable practice, and the loss from hand labor explains why this method is not acceptable. The author estimated that to control the weeds by hand labor in al the S. corn crop in a period of 6 weeks would require .7 million people working 40 hours per week. This is four times as many people as were employed on all U.S. farms in 1973.

Comparisons Of Energy Utilization, Crop Yields And Economics Of Conventional vs. Organic Farming

Several attempts have been made to compare energy utilization i organic and conventional farming systems. In some instances, the comparisons were based on specific field observations, in other nstances not. In some of the studies, yields of crops were reported. In some, economic calculations were made. The various studies differed in the degree to which organic methods were followed. Some of the studies were on an individual crop basis, others on whole farm basis. Farms also varied as to types of crops and livestock raised. A few had arge outside sources of animal manure or municipal ludge. some cases the farms compared were in different geographic areas. Yields often were estimated by farmers rather than being precisely measured and thus are open to question, especially for hay and pasture Because energy utilization, yields and economics are related and because the information reported s so heterogeneous it is al summarized in this section in preference to segregating the energy, yield and economic information for separate consideration

Klepper et al 1977) estimated that, averaged over years, the energy required to produce a bushel of corn on 14 midwestern organic farms was only 36 percent as much as that required on conventional farms; energy for soybean producti 85 percent as much. The energy consumption per dollar of crops produced was 42 percent as great on organic farms as on conventional farms, and the energy consumption per acre of cropland was 38 percent as great on organic farms as on conventional farms. In the same study over a 3-year period (Lockeretz et al., 1978), the unadjusted per acre value of all harvested crops was reported to be 89 percent as great on the organic farms as on the conventional farms. After adjustment for differences in soils and assignment of varying credits for pasture, these values ranged from 78 to 87 percent as great on the organic farms as on the conventional farms (Table 5). Because of lower costs on organic farms, the unadjusted net returns per acre of cropland were estimated to be the same for the two farming systems. It woul of course be appropriate to adjust net returns in a manner similar to that used to adjust gross values per acre of harvested cropland.

On the conventional farms in the study, one-third of the corn acreage wa preceded by a sod crop, and one-half had received an average of 9.1 tons of manure per acre In addition, the average application of commercial nitrogen fertilizer (101 pounds per acre) was approximately 30 percent above that recommended for these situations Boone et al 1978). Therefore, nitrogen avai able from sod crops, manure and fertili- was unnecessarily high for the yields obtained, thus raising the energy input above that needed on these farms.

Berardi (1976) reported that, in wheat production, organic farms used considerably less energy and had lower yields, but obtained roughly the same per-acre net returns as their conventional counterparts.

Oelhaf (1978) found considerable variation in the economic viability of organic farming methods, but he suggests that organic production of a number of commodities can be as profitable, if not more so, than conventional production techniques. Using USDA and other data he estimated that organic farming would add an average of 9.2 percent in production costs for wide range of feed grains, fruits and vegetables and would require an average of 16 percent more labor.

Farming systems of the Amish religious group, though different in motivation, are similar to organic farming in that no pesticides and usually little or no commercial fertilizer are used. Johnson et al. (1977) (Table 5) compared yields and energy input/output relationships for Amish and non-Amish farms in Illinois, Pennsylvania and Wisconsin. Production of grains, hay and livestock was aggregated by converting each to megacalories.

In Illinois, production per acre was 62 percent as great on Amish farms as non-Amish farms The rati of energy output in agricultural products to energy input was 0.89 on the Amish farms and 0.70 on the non-Amish farms.

In Pennsylvania, production on Amish farms of the Nebraska subsect was 56 percent as great as that on the non-Amish farms, and production Amish farms of the Old Order subsect was 103 percent as great as that on non-Amish farms. The ratio of energy output in agricultural products to energy input was 1.51 on the Amish farms of the Nebraska subsect, 1.01 on the Amish farms of the Old Order subsect and 0.55 on the non-Amish farms.

In Wisconsin, production on Amish farms was 78 percent as great as that on small (177 acres) non-Amish farms and 63 percent as great as that on larger (266 acres) non-Amish farms. The ratio of energy output in agricultural products to energy input was .61 on the Amish farms, 0.27 on the small non-Amish farms and 0.40 on the large non-Amish farms.

In the various comparisons of energy output per unit of energy input, the efficiency of energy use on the Amish farms ranged from 1.3 to 5.9 times greater than that on non-Amish farms. In terms of energy input per acre, the values on the Amish farms ranged from 13 to 49 percent as great as those on the non-Amish farms with which they were compared.

The Center for Agricultural and Rural Development (Olson and Heady, 1979) produced a national model for 1980 of the effects on land use, exports and income of three approaches to agricultural production--(I) conventional farming with exports projected at recent trend levels, (II) conventional farming with exports at a level that would utilize nearly all available cropland, and (III) organic farming with exports as in (II). Yields generated by application of the model range from about 30 to 50 percent for organic farming compared with conventional farming (Table 6). According to the authors, "The organic farming yields are lower due to both no use of chemicals and the necessity of using less productive land to meet total demands."

Energy For The Future

If and when oil and natural gas must be rationed, a national decision will have to be made on agriculture's priority for these energy sources. At present, only about 3 percent of the total amount of energy used in the United States is devoted to agricultural production (mining ores, manufacturing steel, fabrica-

Table 5. Crop yields in organic and conventional systems

Organic vs. conventional farming comparison	Yields on organic farms as percentage of yields on conventional farms[a]
Amish vs. non-Amish farms in various areas, total aggregate production of crops and livestock per acre[b]	
Illinois (11 Amish vs. 5 non-Amish farms)	62
Pennsylvania	
Old Order Amish (12 Amish vs. 6 non-Amish farms)	103
Nebraska sect (5 Amish vs. 6 non-Amish farms)	56
Wisconsin	
Ten Amish vs. 14 small non-Amish farms	78
Ten Amish vs. unstated no. of large non-Amish farms	63
Wheat yields in New York and Pennsylvania[c]	
Entire sample (ten pairs of farms)	78
Six pairs of farms with comparable acreages	89
Aggregate crop value per acre of harvested cropland on 14 pairs of midwestern farms[d]	
Values unadjusted for land not cropped	89 (87)[a]
Values adjusted for land suited to cropping but not cropped	
Credit for grazing at one-half the value for rotation hay and pasture	84 (82)[a]
Credit for grazing equal to rotation hay and pasture	86 (84)[a]
No credit for grazing	80 (78)[a]
Corn yields, five farms, various locations[e]	85
Soybean yields, three farms, various locations[e]	107
Wheat yields, four farms, various locations[e]	91
Miscellaneous crop yields, 18 farms, various locations[e]	97

[a] Values in parentheses are adjusted for differences in soils.

[b] Johnson et al. (1977). Yields are farmers' estimates.

[c] Berardi (1976). Yields are farmers' estimates.

[d] Lockeretz et al. (1978). Yields are farmers' estimates.

[e] Oelhaf (1978). Some of the values are organic farmers' estimates of their yields relative to their estimates of yields obtained by their neighbors who were conventional farmers. Others are organic farmers' estimates of their own yields relative to the state average yields. In the instances documented, the state average yields were for different years than the farmers' yields.

Table 6. Estimated national average crop yields under conventional and organic farming (Olson and Heady, 1979)

Crop	Yields in bushels per acre with indicated alternatives[a]: Conventional farming, Alternative I	Conventional farming, Alternative II	Organic farming, Alternative III	Yields with Alternative III as a percentage of yields with Alternative II
Wheat	45.8	43.1	20.1	46.6
Corn	99.4	98.1	49.3	50.2
Other feed grains[b]	55.0	57.0	17.2	30.2
Soybeans	40.8	40.0	19.7	49.2
Cotton[c]	1.5	2.5	1.1	44.0

[a] See the text for a description of the alternatives.

[b] Other feed grains are in corn-equivalent bushels.

[c] Cotton is in 500-lb bales per acre.

ting machinery, producing fertilizers and pesticides, fueling tractors, harvesting and drying crops, operating livestock buildings, etc.) (U.S. Department of Agriculture, 1976).

The 3 percent figure given here for energy use in agricultural production is less than one-fourth of the amount of energy expended "from the farmer's gate to the dinner plate" (i.e., for transporting, processing, marketing, storing and cooking the food) (Federal Energy Administration, 1975). Thus, the energy saved by organic farming would apply only to the 3 percent used in actual production and not to the 16.5 percent estimated to be used in the total food system. A change from conventional farming to organic farming methods would have little impact on national fossil fuel consumption because its main direct effect would be on the energy used to produce and use agricultural chemicals. These require about 40 percent of the energy used in agricultural production or about 1 percent of the energy used in the United States (U.S. Department of Agriculture, 1976). The net effect would probably be less than a 1 percent reduction in national energy use because if agricultural chemicals were not used more energy would be expended in tillage and in farming additional land.

In spite of the relatively small proportion of the total U.S. energy consumption that is devoted to agricultural production researchers are giving increasing attenti to conserving energy, improving the efficiency of energy use, and developing alternative sources of energy for future use in agriculture. Progress is being made. For example, the poultry industry is reducing energy use by improving the insulation of shelters and substituting animal heat for fossil fuel energy Use of solar and wind energy is increasing. The mo expensi energy becomes, the more important it will be to obtain the maximum benefits from the amounts and forms used, whether they are employed in conventional farming, in organic farming or in other aspects of the economy.

IMPLICATIONS OF INCREASED ADOPTION OF ORGANIC FARMING METHODS[9]

This section attempts to assess the effects of substantial shifts from conventional to organic methods of farming. Considered will be the impacts on crop production, land use and ivestock production as well as the possible economic implications for farmers, consumers and the nation as whole.

Crop Yields

In the organic-conventional comparative studies reported in Table 5, yiel reductions attributed to organic farming ranged from -7 to 44 percent. (Excluded are the data from organic farms on which outside sources of manure or municipal sludges were reportedly used.)

We estimate that, for farming in a mixed grain-livestock system without nitrogen fertilizers and pesticides, aggregate yield reductions would be 15 to 25 percent if there were ittle or no change in cropping patterns.[10] A major shift in cropping patterns on cash grain or vegetable farms to nsert nitrogen-fixing legumes would lead to a much greater reduction in production of grain and vegetable crops on these farms because of the smaller acreages n these crops in any given year. The decrease in production would probably increase aggregate farm income because the percentage increase in farm prices woul be expected to exceed the percentage decrease in production. On individual farms, either marketed legume hay or additional livestock products would probably partially offset the loss of potential income.

Acreage Needed

To offset a 15 percent decline in production on present land due to adoption of organic farming methods woul require 18 percent more of the same kind of land to produce the output obtained by conventional methods. Because currently there is little idle land where soils and climate are favorable the additional land would be less productive, and mor of would be needed. At least 20 to 25 percent additional less-well-suited land would be required.

To offset a 25 percent production decline would require 33 percent more of the same kind of land to produce the same output by organic farming methods; this would translate to perhaps 40 percent or more additional less-well-suited land. In Illinois, for example, it is estimated that 39 acres of land-use capability subclasses IIIe and IVe would be needed to replace 1 acre of average current cropland (Aldrich et al., 1971).

The same principle would apply if there were a partial shift to organic farming, as some have suggested. A partial shift would merely decrease the amount of additional less-well-suited land required.

Erosion Potential

Much of the land available for cropland expansion is on slopes and, thus, susceptible to erosion. If legumes become part of the cropping sequence on intensively cropped, nearly-level land, more row crops would have to be planted on the sloping land to maintain the output; this would mean increased erosion. Erosion from slopes of 2 to 4 percent is 2.6 times greater than that from nearly level land (0 to per-cent slopes); and from slopes of 4 to 7 percent, it is 6.2 times greater (Lee and Stall, 1978).

9 In e situations organic farming is not feasible. These include (1 dry regions where growing nitrogen-fixing legumes in rotation is impractical; (2) crops for which pesticide use is essential; (3) soil which, for reasons of wetness, steepness, stoniness, etc., is not suited to crop rotations; and (4) wet seasons in which adequate weed control without herbicides is impossible.

10 Part of this reduction is attributable to a lack of enough organic matter and farm-grown nitrogen to supply currently used quantities of plant nutrients, and part is attributable to increased pest losses for some crops in some areas.

Animal Production

Legume Nitrogen vs Fertilizer Nitrogen

Reliance on legumes instead of fertilizer to supply supplemental nitrogen for crop production would reduce the productivity of cash grain and vegetable farms for grain and vegetable crops because the proportion of the time these crops could occupy the land would be reduced. As noted previously, livestock or poultry would probably be introduced, either on the individual farms or on others to which legume hay would be sold, in an attempt to mitigate the loss of economi efficiency of the system.

A further consequence of reliance on legume nitrogen would be a reduction of grain production for the market. In regions such as the Northeast and East that are already deficient in grain and that import grain from other regions, the likely result would be an increase in local grain production on soils less wel suited for the purpose and under climatic conditi less favorable than those in the Midwest.

Animal Nutrition

Increasing livestock and poultry numbers as a means of increasing the amount of available manure to replace fertilizers is sometimes cited as a goal of organi farming. Feeding crops to domestic animals s in the anure for return to the soil a portion of the nutrients that would otherwise be sold off the farm in the crops, but it does not resul in net addition of plant nutrients unless feed or manure is imported from off the farm, which would impoverish some other land.

In conventional farming, extensive use is made of nutritional supplements in animal feeds. The significance of chemical additions not provided for in the organic system is seen most vividly where the soil is markedly deficient in one or more nutrients. Allaway (1975) mentioned the following examples:

> The cattle of the early colonists of the Sacco Valley of New Hampshire suffered from "wasting disease, which was attributed to placed on the valley by the Indian Chief Chocorua. The "curse of Chocorua" is now known to be due to cobalt deficiency When the Columbia Basin of Northwestern United States was first used for irrigation agriculture, zinc deficiency was so severe that corn and bean crops failed on many farms. These naturally occurring deficiencies and many similar ones have since been corrected by such of iodized salt, trace element fertilizers and mineral supplementation of animal diets

Animal manures, if available in adequate amounts, will often correct certain micronutrient deficiencies, but there are exceptions. Allaway noted:

> Corrall disease term used to describe zinc deficiency in citrus trees growing on sites that have received heavy applications of manure. Some organic materials may tend to make copper less available to plants. Severe deficiencies of copper resulting i low crop yields and copper deficiencies in grazing animals are common problems on highly organic soils such as peats and mucks.

Mineral and other nutritional supplements increase animal productivity, and they are of greatest importance in feeds for poultry and swine. In cattle feeding, considerable use is made of urea as an economical nonprotein source of nitrogen. The bacteri in the r men incorporate the urea nitrogen into microbial protein, which is subsequently digested and converted in part to animal protein. Such use of urea upgrades the nutritional quality of low-nitrogen roughages such as cereal straw corn fodder and sugar cane bagasse for cattle. It spares natural protei sources, allowing thei use for feeding to nonruminant species that cannot use urea nitrogen. Approximately one-third of the dietary nitrogen for cattle can be supplied as urea without decreasing the rate of gain.

The minerals and nonprotein nitrogen used to improve the nutritional quality of animal diets in conventional farming lso improve the qual ty of the manure as fertilizer because much of the quantity of these substances supplied the feed excreted in the manure. Avoiding the use of mineral and itrogen supplements animal nutrition would reduce the efficiency of animal production and would increase the area of and needed to produce animal products.

Use Of Hormones And Other Substances

Further increases in producti efficiency are achieved in modern conventional animal agriculture by use of hormonally active substances (Butler et al., 1977). Hormonally active substances perform two important functions. The first, and potentially the more economically important, is the use of hormones to improve reproductive performance and to facilitate genetic improvement. Technology is currently available so that hormones may be used to induce parturition swine and cattle. Induced parturition can decrease losses of offspring and decrease the time needed for animal care Hormones can be used to induce lation, making artificial insemination more practical and effective; to induce twinning; and to increase the genetic contribution of superior cows by facilitating embryo transfer to, and propagation in, foster mother Practical realization of the full benefits from these uses of hormones is yet to be achieved.

The second function performed by artificial administration of hormones is promotion of ani growth The hormones used for this purpose ncrease the rate of gain and reduce the amount of feed required per pound of body weight gained Increases in feed efficiency of 10 to 15 percent for growing and finishing beef cattle are common with the hormone implants available (Beeson, 1979). Use of monensin (a nonhormonal substance) in the ration of beef cattle increases the feed efficiency to about the same extent as the hormone products (Potter et al., 1976; Raun et al 1976).

Most of the hormones and other active substances useful in conventional animal agriculture are naturally occurring organic compounds but their purposeful use is unnatural and thus is objectionable to some persons. Their value in increasing the efficiency of resource use in animal production is lost in "organic" systems that do not use them.

Animal Health

Certain drugs are now used in conventional animal agriculture to protect anima health and, hence to reduce morbidity and mortality and to increase production efficiency. These i lude antibacterials, anthelminthics arvacides and antiprotozoals.

Drugs are useful in both conventiona and organi systems of farming, but organic farmers prefer not to use them. Although the current trend toward increas-

ing numbers of animals in the same facilities increases the need for drugs to protect animal health, others factors remaining equal, many of the larger units are not farming operations in the usual sense but are separate enterprises.

Some of the drugs employed are naturally occurring organic compounds, and some are synthesized. The use of drugs for animals is controlled by the Food and Drug Administration, which has the responsibility for assuring that they are safe and effective for the intended purpose, as well as the responsibility for assuring that residues that might be hazardous to humans do not occur in the edible products.

Opportunities to reduce the degree of reliance on pharmaceutical exist at present and can be expanded further by research. For example in poultry production, the need for medication to reduce health problems can be reduced by controlling the temperature and humidity, by controll ng the gases evolved from the manure and by supplying diets of high nutritional quality. Future opportunities ist to improve the genetic potential for resistance to diseases and parasites. Animals with suitable genetic qualities need little help from pharmaceuticals.

Economic Impacts

Assessing the economic feasibility of an organic approach to farming is appropriately left to individual farmers. Individual farmers may make different decisions because they differ in goals soi., labor and capital resources in availability of fertilizer substitutes (animal manures sewage sludge in environmental conditions and n access to special markets. In addition they may differ in personal preferences, value judgments about pesticide safety and relevant social issues, and in other respects that may influence their decision.

Farming organically may be a strategy chosen by certain farmers to lower production costs, adjust to higher energy prices or lessen the uncertainty of energy-intensive input supplies In some instances, they may be able to substitute family labor for farm machinery or for herbicides to control weeds. Organic farming methods may also be attractive to some new entrants into agriculture who lack the funds for getting started.

The economic impacts of an increase in adoption of organic farming would depend largely on the degree and extent of adoption. Limited adoption, in which farmers might be able to take advantage of a special market under current economic conditions, would probably have little direct effect on consumers or the agricultural community. Widespread adoption, on the other hand, would have large impacts on both.

Farm Income And Farm Prices

Aggregate farm income would increase as a result of a substantial shift to organic farming. The principal reason is that total production from the land involved would decrease, and the percentage increase in price of agricultural products would exceed the percentage decrease in production.

Each 1 percent decrease in crop production would mean an estimated "farm-gate" price increase of 1 to 5 percent, depending the type of crop and whether it is consumed domestically or exported.[11] The average increase would likely be to 4 percent. The resulting percentage price increase for all food at the retail level would be approximately one-third of the farm-gate crop price increase--or from 0.75 to 1.50 percent for each 1 percent decrease in production. Thus, a 10 percent decrease in agricultural output would result in an estimated 20 to 40 percent increase in prices to the farmer and a 7.5 to 15 percent increase in retail prices.

The impact of a major switch to an organic system would not be evenly distributed among regions, among farmers or among consumers Regions with serious insect, disease, nematode and weed problems that could not be adequately controlled without pesticides (e.g., the cotton, corn and soybean producing areas in the South and Southeast, and fruit and vegetable farms generally) would be negatively impacted. Regions or farming systems with less serious pest problems (e.g., the corn-soybean system in the Midwest, except for weeds, and rangeland livestock operations generally) would likely reap larger benefits. Cattle feeders would substitute legume hay for part of the feed grains now used.

Prices for crops that are intensive nitrogen ferti izer users would increase sharply, whereas prices for legume crops might decrease. Regions not having adequate sources of organic matter or where legume sources are not feasible, such as the dryland wheat producing area, would also be negatively affected. Much of irrigated agriculture in the West would be severely impacted, especially in the long term. Irrigation is expensive, and the cost of legume nitrogen would thus be higher in irrigated agriculture than in rain-fed agriculture. Moreover, where the source of water is underground reservoirs that are only slowly rechargeable, water that might otherwise be used to produce a crop of higher value than the legume would be lost from the system and would not be available for subsequent use

At thei present numbers, many organic farmers receive higher prices for their products than do conventional farmers because they supply a special market. According to *Organic Gardening* Editor Robert Rodale (1973):

> There are perhaps 10,000 organic farmers in America today, managing farms of all sizes. And they are reporting surprising business success, mainly because the fast-growing market for health foods is supplied in large part by organic farms. The yields of organic farmers may average less than those of comparable conventional farmers, yet they often receive higher prices for their crops because they sell to a specialty market.

This advantage of course, would disappear if the number of organic farms increased sufficiently to supply more product than the market could absorb.

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[11]Following are estimates of farm-gate price flexibility coefficients:

	Domestic	Export
Feedgrains	-5.0	-1.67
Feedgrains	-4.0	-1.33
Oilmeal	-2.5	-1.00

These values define the expected percent change in farm-gate price resulting from a 1 percent change in output of the indicated group of commodities. The total market value of the crop is increased by reductions in the size of the crop if the price flexibility coefficient is absolutely greater than -1.0 (Taylor et al., 1977).

Land Prices And Farm Size

Increased net farm income would lead to higher land values throughout the United States. Thus, current landowners would benefit, but financial constraints would be imposed on the entrance of potential new farmers.

Current knowledge of the interrelationships between various factors of agricultural production suggests that an organic approach might encourage and reinforce the viability of family farms in the small- to medium-size range. It is not known to what extent this might be offset by the tendency to drive up the price of land, thus bringing more outside capital into agriculture and promoting large farms.

Labor Demand

If organic farming were increased substantially, agricultural production would decrease, prices would rise and cultivation of additional, less productive land would be encouraged. The additional labor required to farm this land, plus whatever increase in labor intensity might be needed for use of organic methods on land previously cultivated by conventional methods, would increase the demand for farm labor and would cause wages to rise.

A shift to a more labor-intensive American agriculture would entail difficult adjustments and social costs for many persons. For instance, although there are unemployed persons in the United States, most of them do not live in rural areas and are not trained for farm work. Local housing near farm employment opportunities would be inadequate. And it is doubtful, at least at present, that some of the urban unemployed would be receptive to the types of work involved on farms, especially the menial tasks.

Exports And Balance Of Payments

Exports of agricultural products would be adversely affected by large-scale adoption of organic farming. One national model indicates that, in 1980, the amount of wheat plus corn available for export would be 4.6 billion bushels under conventional farming and 900 million bushels under organic farming (Olson and Heady, 1979). Much of this difference would be due to the substantial shift from grain crops to forage legumes to supply nitrogen.

In the long run, the price increases resulting from decreased production would encourage importing countries either to increase their own production or to seek other sources, thus reducing the dollar value of U.S. agricultural exports and increasing the balance-of-trade deficit. In the short run, the dollar value of exports may be expected to decrease only moderately because of partially offsetting price increases. This initial reduction in value of exports would be substantially less than that which would occur with a long-term U.S. commitment to organic farming.

Our present capability to produce greater quantities of certain agricultural commodities than are needed for domestic consumption can also be used to support the alternative position that the loss in export capability due to a shift to organic farming would be an acceptable tradeoff for reducing the use of commercial fertilizers and pesticides in conventional agriculture. This proposition involves value judgments that must be made by members of society at large or by their elected representatives.

ORGANIC FARMING RESEARCH

Both organic farmers and conventional farmers are served by research on genetic improvement of crops, planting dates and rates, tillage, nonpesticidal means of pest control, and certain other management practices. Both organic farmers and conventional farmers are served by research on soil organic matter, soil structure and other soil properties, soil-plant relationships, energy and the environment. Research on fertilizers and pesticides benefits primarily conventional farmers.

In earlier years, much research was done on cropping sequences, nitrogen fixation by legumes, utilization of crop residues, and manure preservation and application--all matters of special interest to organic farmers. This information is recorded in the literature and is available to all, but relatively little such work is being done at present.

One area now being emphasized in fundamental nitrogen research is that of developing the capability of nitrogen fixation in nonleguminous plants. Although success in this endeavor is not soon anticipated, it would have a major impact on agriculture. Organic farmers would not need legumes to supply nitrogen, and conventional farmers would not need nitrogen fertilizers. The most visible distinction between organic and conventional farming--crop rotations including legumes--would disappear. The "nitrate problem" that is viewed by some as an indictment of conventional farming would then become an organic farming problem as well, as is explained on page 14.

Considerable research is being conducted also on "conservation tillage" methods, which involve stirring the soil less and maintaining more crop residues on the surface of the soil than is true of conventional farming. Conservation tillage aids in soil erosion control. Whether research on conservation tillage should be classified as research on organic farming or conventional farming may be debated, but its effect is to change conventional farming in the direction of organic farming as regards tillage intensity and erosion control. At present, the ultimate version is "no till," in which the crop is planted without previous plowing or disking and without subsequent tillage, the weeds being controlled by herbicides. In some variations being tested, a legume is used as an intercrop to supply nitrogen and to aid in weed control. Except for the herbicide usage, this variation of conservation tillage results in a form of agriculture more "organic" than the usual organic farming. The tillage practices used in conventional farming are more generally applicable than are many conservation tillage practices, but farmers are adopting conservation tillage wherever the combination of method and conditions proves advantageous.

ORGANIC GARDENING

This report deals primarily with organic farming because our food supply depends for the most part on farming. Many of those in the organic movement are gardeners, however, and so this section is addressed specifically to gardening. Organic gardening is not just small-scale organic farming. In comparison with production involving use of commercial fertilizers and pesticides, organic gardening is considerably more attractive than is organic farming.[12]

Applicability Of Methods

The most important distinction between organic gardening and organic farming is the ease with which the organic matter grown in the garden itself may be supplemented by organic matter derived from other sources. The extra organic matter contains plant nurients and alleviates the need for commercial fertilizers, and it improves the physical properties of the soil.

Fallen leaves and lawn clippings from the home site need to be disposed of, and a garden is a good place for the purpose. Supplemental plant residues, animal manures and other wastes can sometimes be obtained from neighbors, nearby farms municipal sewage treatment plants or nearby garden upply retai stores. Organi matter may be obtained free of charge from some of these sources, but where i must be purchased the cost is not such an important factor as it likely to be in organic farming because many organi gardeners view their gardening activities as an avocation in which costs are not of primary concern.

The leaves, grass clippings garden residues and other organic materials are mos effectively handled by putting them compost pile and allowing them to decompose part before adding them to the garden. Composting kills plant disease organisms if the temperatures attained in the compost pile are high enough. Although the value of the organic matter in improving the soil is greater if the organic matter is incorporated directly into the soil than is partially decomposed before addition, the amount of organic matter added in organic gardening is often so great that the difference in effectiveness is of little concern.

A second difference s that gardening without of herbicides to control weeds is much easier than farming without herbicides. Hand weeding presents a real problem on organic farms because of the relatively large area concerned, but is feasibl in home gardens. Labor for hand weeding n home gardens is usually free and often is viewed as recreation. Moreover, some of the organic matter added to the soil may be applied as mulch, which helps to control weeds.

A third distinction is the greater freedom of choice among fruits, vegetables and ornamentals that may be grown by gardeners. Because organic gardening is more often a hobby than a commercial enterprise, the gardener can often avoid species that offer pest problems without concern for the financial aspects of the production or sale of the products. Sometimes plants in home gardens escape diseases and insects because they are isolated from sources of infection or infestation.

[12]For a practical guide to organic gardening and a list of many references see Fletcher et al. (1972).

Finally, if the yield is poor or if part of the produce is destroyed by pests, the organic gardener can purchase the needed products at the supermarket without suffering financial disaster.

Pesticides can be applied safely by the conventional home gardener if the instructions on the label followed but hazards of possible misuse are eliminated by organic gardeners that do not use pesticides. Commercial ferti izers may be used to advantage by conventional gardeners. Nonetheless, commercial fertilizers are relatively concentrated forms of plant nutrients and may easily damage plants if applied incorrectly or in excessive quantities. Compost and other organic soil amendments used by organic gardeners contain lower concentrations of soluble plant nutrients and are less apt to damage plants. Improperly applied fresh ivestock and poultry manure, however, can cause injury to plants due to excessive salt and ammonia concentrations.

Controlling Pests

A home gardener who desires to grow a wide variety of fruits and vegetables will find that some insects and diseases cannot be effectively controlled at present without pesticides. Consequently, some fruits and vegetables simply cannot be satisfactorily grown if use of pesticides is ruled out.

Informati lacking the value of releasing natural enemies for insect control in the wide range of vegetables and fruits usually grown in home gardens. Some predators attack only a single or closely related insect species and thus do not control all of the many types of insects found in the home garden (cabbage worm, potato beetle, squash bug, flea beetles cutworm, aphids, rworm, etc.). The preying mantis, on the other hand, not selective but feeds on beneficial insects such as ladybird beetles as well as on insect pests

Presently, there is little evidence to indicate the effectiveness of "companion crops" in either repelling insects from the area or attracting them away from fruits and vegetables

Nematodes present special problems for home gardeners, especially in the South. High concentrations of vegetables in small areas in which there limited space for crop rotation increase the likelihood that such pests as root-knot nematodes wi be serious. The hazard is often ncreased by incorporating organic residues because these may be infested with nematodes. A commercial nematicide is often the best control thod at present. Breeding for nematode resistance (already achieved in some tomato and sweet potato varieties) appears to be a promising alternative for the future.

Providing Plant Nutrients

Unless provided from outside sources, the supply of available nitrogen is often marginal or deficient in organic home gardens. And unless adequate amounts of well-rotted plant residues and kitchen wastes or animal manure are used, garden yields are likely to be disappointing without commercial fertilizer.

Compost is the primary source of home-grown nitrogen. However, most instructions for preparing compost suggest that nitrogen fertilizer be added to hasten decomposition of the residues. Making compost is a technique for avoiding the tie-up of available nitrogen in the garden while the organic residues are decaying. The residues decay outside the garden soil and are incorporated after the initial period of nitrogen tieup.

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Organics on the Farm and in the Garden

(By Dr. Berlie L. Schmidt)[1]

Organic farming and conventional farming are two differing philosophies of farming. Most farmers, being pragmatists at heart, opt for the most financially advantageous combination of practices.

THE ORGANIC-CONVENTIONAL DISTINCTION

For the purists, there are definite categories. Organic farming has been defined as "a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives." Organic farmers prefer to rely on "naturally occurring chemicals," such as limestone, phosphate rock, animal manures, and nitrogen fixed from the air by leguminous crops. Conventional farmers are not concerned about this distinction. They use these naturally occurring chemicals as well as the products of modern agricultural chemical technology, ranging from fertilizers to animal feed additives.

THE COMMON GROUND

Aside from the obvious gap on processed and synthetic chemcial usage, there is much common ground between organic and conventional farming. Both use genetically improved seeds and other plant stocks, and both use genetically improved animals. Conventional farmers use modern farm machinery powered by gasoline or diesel fuel, and so do most organic farmers, despite the fact that gasoline and diesel fuel are processed chemicals. Both practice return of organic matter to the land. The amounts returned are often greater in conventional farming than in organic farming because of the higher crop yields on conventional farms. Under both systems the organic matter content of most soils decreases from the content in the original uncropped solid to a lower maintenance level.

Organic farmers usually rely on the nitrogen fixed from the atmosphere by legumes to supply some of the nitrogen required by the nonleguminous crops that follow. Many conventional farmers grow these same legumes (often alfalfa or clover), and they use them for the same purpose—livestock feed. Farmers with livestock operations, whether organic or conventional, apply animal manures to the soil to act as a fertilizer and conditioner. But conventional farmers generally find it profitable to substitute nitrogen fertilizer for part of all of the legume nitrogen. They commonly use additional quantities of nitrogen and other plant nutrients from commercial fertilizers for the same reason. Crop residues and manure return only a part of the nutrients removed from the soil by crop growth.

To control pests, such as weeds, insects, and plant disease causing agents, both types of farmers take advantage of resistant crop varieties and tillage. Organic farmers lean heavily on crop rotation for pest control, but many conventional farmers substitute use of pesticides for crop rotation as a means of controlling pests, largely because of improved economics and farming system preferences.

PRODUCTION EFFECTS

The use of modern agricultural chemicals increased the yields of crops per acre and permits agricultural production to be concentrated on the best land, where production is most economical. To produce the same output without chemicals would require more land. Most of the available land would have relatively low productivity and relatively high susceptibility to erosion.

At the same time, the use of modern agricultural chemicals allows conventional farmers to grow more acres of the more profitable row crops and fewer acres of the less-profitable, close-growing crops that help inhibit soil erosion. Planting row crops on steeply sloping soils without adequate safeguards can increase soil erosion.

Rapidly increasing numbers of conventional farmers now seek to combat erosion with conservation-tillage practices. These practices, now used on about one-fourth of U.S. cropland, leave some of the crop residues on the soil surface as a protective mulch. In changing to conservation tillage, conventional farmers substitute the use of herbicides as needed for "clean tillage" used by organic farmers to provide weed control. Strict organic farmers do not find this substitution acceptable.

According to a task force of university and government scientists, adoption of organic farming methods by conventional farms now using a mixed grain-livestock

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system would result in decreases in crop yield estimated at 15–25% per acre if there were little or no change in cropping patterns. To offset a 15% decrease in production on present land would require farming 18% more land of the same kind. That land is not readily available. Most of the land that could be brought into cultivation would be more prone to serious soil erosion.

ORGANIC GARDENING

While most farmers continue to supplement the use of natural chemical substances with processed and synthetic chemicals to improve their production, many gardeners find that the organic concept is much better suited to their operations. Organic gardening is not just organic farming on a smaller scale. The most important distinction between the two is the ease with which organic matter grown in the garden may be supplemented with relatively large amounts of organic matter produced elsewhere. Returning organic matter to the soil to aid in maintaining soil productivity is a central idea in the organic concept.

Fallen leaves, grass clippings, garden residues, and kitchen refuse need to be disposed of somewhere, and the garden is the perfect place. Putting these organic materials in a compost heap and allowing them to decompose for a few months will prepare the material for the garden and will kill plant disease organisms if the temperature attained in the compost pile is high enough. Compost applied to the garden acts as a fertilizer that brings in plant nutrients from other areas. It also has other valuable effects. It improves the physical condition of the soil and, if applied as a mulch, aids in stopping weeds.

Gardening without using herbicides to control weeds is much easier than farming without herbicides. Hand weeding presents a real problem on organic farms covering a relatively large area. But it is manageable in a backyard garden.

Organic gardeners have another advantage over organic farmers in that they have greater freedom to pick and choose among the plants they grow. They can select pest-resistant species, since they are not bound to produce crops to sell to make a living. And of course if the backyard crop should fail as a result of pest problems, no financial disaster ensues. The local supermarket can pick up the slack.

Commercial pesticides and fertilizers may be used to advantage by conventional gardeners, but must be applied with care. Unless the directions are followed closely, plants may receive improper doses of these concentrated substances. The avid home gardener, hoping to produce a wide variety of fruits and vegetables, may find that some pests of some crops cannot be combatted effectively without pesticides. Such crops may be avoided. In some instances, alternative means of control may be available. For example, nematodes present special trials for the home gardener, especially in the South, because most nematicides can be applied only by persons who are certified applicators. (Nematodes are microscopic, worm-like organisms that attack the roots of plants—see *Science of Food and Agriculture,* Volume 1, Number 3, page 16.) Alternative means of control include using resistant crop varieties (there aren't many of these), tilling the soil while it is dry, destroying the crop after final harvest (exposing the roots to sun and wind), clean fallow, applying organic matter, and growing a solid stand of marigolds for a year. Marigolds produce a root exudate that controls certain nematodes. They may also inhibit the reproduction of certain nematodes that enter their roots.

Plants in the home organic garden are likely to be deficient in nitrogen unless help is provided from outside sources. Unless adequate amounts of well-rotted plant residues and kitchen wastes or animal manure are used, garden yields are likely to be unimpressive.

Compost can be an important source of nitrogen for home gardens. Most instructions for preparing compost suggest adding nitrogen fertilizer. This will hasten decomposition of the residues. It will also shorten the time during which the compost will remove available nitrogen from the soil to supply the microorganisms decomposing the organic matter instead of having the desired effect of supplying available nitrogen for the garden plants. But nitrogen fertilizer is not essential. Compost eventually will reach the stage at which it supplies available nitrogen for the garden plants even without addition of nitrogen fertilizer to facilitate the composting process.

Although there is much interest in the controversy between organic and conventional farming, it seems that the most successful adopter of the organic philosophy will be the weekend gardener.

COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY,
Ames, IA, May 10, 1984.

Mr. DAVE HILL,
Committee on Agriculture, Nutrition, and Forestry,
Russell Senate Office Building, Washington, DC.

DEAR MR. HILL: Thank you for your telephone call this afternoon relative to H.R. 2714, the "Agricultural Productivity Act of 1983." We don't have H.R. 2714, but we do have a copy of House of Representatives Report No. 98-587 entitled "Improving the Productivity of American Farms," which was developed to to accompany H.R. 2714. This Report gives a modified version of H.R. 2714.

In response to your request, I would offer two general comments. First, it is good to see from the fact that H.R. 2714 was passed by the House that members of this body generally are supportive of research to evaluate the relative merits of organic versus conventional farming. Second, the research proposed in the bill would produce disappointing results. In the following paragraphs I shall elaborate primarily in the second comment.

The bill proposes to evaluate the relative merits of organic and conventional farming for dairy farms, other livestock farms, field-crop farms, and fruit or vegetable farms on a farm basis in 5 years with a total of only twelve organic farms and twelve conventional farms. In my opinion, there is no possibility that an adequate evaluation can be obtained in the manner described.

It is a small help that Section 6(b) gives the Secretary of Agriculture the flexibility to modify the type of farms selected. But this is still far from enough.

The deficiency of the experiment described in the bill for producing the desired answers results from two basic facts: (1) Some of the important advantages and disadvantages of the organic system may take more than 5 years to develop. (2) Agriculture is complex. Conditions and management practices are many and variable. What works in one area may not work in another. What works well on one kind of soil may not work well on another in the same area.

I shall elaborate now on the consequences of the complexity. Different farmers do different things in different ways, to different degrees, and under different conditions. Many factors influence the results obtained. As a consequence, when one compares, for example, the economic profitability of two farms of any class, there might be 100 or more identifiable differences that could contribute to the observed difference in economic profitability. Which one or which ones of these 100 or more differences were responsible and to what degree? The data do not give any help in answering this question.

It would be desirable to have information on different aspects of the relative merits of organic and conventional farming; e.g., what are the differences in terms of crop yields, crop quality, economic profitability, soil properties, and soil erosion? Experimentally, a difficulty in making the evaluations desired is that the assemblage of practices called organic farming will not be the same on different farms. Similarly, the assemblage of practices called conventional farming will not be the same on different farms. And because the farms themselves and other conditions will differ, no two organic farms will yield the same results, and no two conventional farms will yield the same results. In short, we shall have variations in results among organic farms and among conventional farms that we have no way to take into account. If the numbers of farms within the organic class and the conventional class are small, the variation in results within classes probably will be so great relative to the difference between average values for the two classes that the latter will provide only a poor estimate of the true difference between classes.

Experimentally, the transition between farming systems could be evaluated on a whole-farm basis as follows: Select a minimum of, say, 80 similar farms that produce the same product, e.g., wheat. Divide these farms into two equal groups of 40 each. Operate each set of farms for, say, 20 years, one with a carefully specified and controlled set of practices that would classify as organic farming and the other with a carefully specified and controlled set of practices that would classify as conventional farming. At the end of this time, divide each group of 40 farms into two equal subgroups. Of those operated for the first 20 years as organic farms, continue 20 for another 20 years as organic farms and change the other 20 to operate for the next 20 years as conventional farms according to the practices used by the 40 conventional farms during the first 20 years. Similarly, divide the 40 farms operated conventionally during the first 20 years into two equal groups. Continue one group as conventional farms for another 20 years, using the same specified and controlled practices as before. But switch the other group to organic farms, using the standard specified and controlled organic farming practices, and continue them in that mode for 20 years.

In terms of the scientific method, what I have described here would be considered a decent design. The absolute number of farms to be used has been assigned intuitively as the minimum needed. Statisticians with more knowledge about this subject could given a better guess. The number of years also has been assigned intuitively as the minimum needed. The reason for the seemingly long time requirement is that some of the important changes in soil and crops associated with a change from one system to another take place slowly and require more than 20 years to reach a fairly stable state.

If the experiment described in the preceding paragraph were accompanied by suitable measurements on the soil, environmental conditions, inputs, and outputs, it should provide the desired answers about the two systems for the one class of farms and the one kind of soil selected for study. The experiment should be repeated for each class for farms and kind of soil for which information is desired.

When one sees what is needed experimentally to do in a minimum fashion what is desired, it is clear that the procedure described in H.R. 2714 is woefully inadequate. And it is clear that even though the Secretary were to modify the plan in accordance with Section 6(b) to change the type of farms selected it would still be woefully inadequate. And, finally, it is obvious why experiments of this kind have not been done on the kinds of budgets available to agricultural research institutions.

An alternative that comes to mind is to use existing data in computer models that have been developed to represent input-output relationships in agriculture. These are not perfect, but they certainly would be far more economical and far more prompt in producing results than would appropriate experiments to make direct comparisons of complex agricultural systems on a farm basis.

I appreciate the opportunity to comment. These are personal comments based upon many years of acquaintance with and involvement in agronomic research. If you think there is some appropriate way in which CAST might be of assistance in connection with further consideration of the issue, please do not hesitate to call upon us.

Sincerely,

CHARLES A. BLACK, *Executive Vice President.*

STATEMENT OF JOHN PESEK, PROFESSOR AND HEAD,
AGRONOMY DEPARTMENT, IOWA STATE UNIVERSITY

It is important for the Congress to provide leadership for research on all agricultural production systems through instructions and appropriations to the United States Department of Agriculture and its federal and state cooperating agencies. S.1128 seeks to identify and direct a research thrust toward a range of crop production systems perceived by some to be neglected. Further, S.1128 provides an appropriation for each of five years to establish demonstrations of trans tion of farms from high technology, high off farm input agricultural production practices to low off farm input and appropriate technology production systems, and to monitor the transition and all changes associated with it, including the gross and net incomes of the owner and/or operator.

PROVISIONS OF S.1128 NEEDING ATTENTION

My main concern with S.1128 is that it establishes a research plan or procedure for observing transition from one farming system to another and for the collection of related relevant information. The "experimental design" proposed in S.1128 is deficient and inappropriate in several ways and probably is not the design which would yield the most unambiguous information for reasonably applicable extension to other farms; an implied goal of the overall study. Some shortcomings of the design which I see are:

1. The number of comparisons is too few--twelve farms or pairs of farms even in one region or representing only one class of farming transition is a very small number and some classes will not be examined at all. Reductions of observations to only two pairs, in some cases, will provide information only remotely applicable with confidence to other farms in the class. This is because the outcome of biological processes and management decisions in agriculture is characterized by much natural variation--soils, climate and seasons vary, farms probably vary more and farm operators even more. Hence as few as two farms in a class provide results with a large range of uncertainty relative to what might be the true mean for the class.

2. The length of the study (five years) is too short. There are several reasons.

a. Perfect or even very close matching of a farm and operator in transition with ones which have made the transition at least five years previously or to continue under common operating procedures is impossible. The standard of comparison then has to be the farm and operator selected to make the transit with the past performance of that same unit. The time span for these "before" observations is no more than one year--yet we all know that one year may or may not be representative of the usual experience. And, from only one year of information, it is not possible to tell how near to or far from the usual the results might be.
b. Many alternative farming crop sequences run a course of four or five years fully to take advantage of the effect of on farm nitrogen production. For crop sequences such as this, four years of observations do not

permit more than one cycle of annual and biennial crops. Fruit and nut crops and cattle have even longer cycles. Can the full benefit of transition be seen this quickly? Probably not.

c. Soil changes occur relatively slowly in response to cropping system changes. As a result, very few soil changes are likely to be "measurable" after one cycle of the system--these changes would be more perceptible after two or three cycles.

d. The major climatic cycle over a large part of the country is approximately twenty years. Hence a four- or five-year study would observe no more than one-fourth of this cycle The results could be very misleading if the observations were during the "best" or the "worst" parts of the cycle.

e. Even without the po ential effect of climatic cycles, four- or five-year averages for crop yields are not very dependable. This stems directly from the inherent variability of outcome of many agricultural practices.

3. The number of "treatment" (alternative production systems) comparisons concerning each transition farm class, e.g., present dairy farm to an alternative dairy farm are too limited. Many answers have to be binary i.e., with or without yes or no; plus or minus; zero or one etc. Are there not several potential operating stages between the minimizing of off farm technology and maximizing it which are all reasonable alternative possibilities and levels of dependence upon resources external to the farm?

4. Comparisons of whole farm operations are highly complex because there are so many factors which can be changed deliberately and others which cannot be or are not controlled. Farm subsystems are more tractable, the models are smaller and problems with intercorrelation of variables are less. Examples of subsystems would be grain production hay production (alternatively, feed production), cow herd management calving operations, finishing, etc. for a grain and livestock farm. Budgeting and other programming procedures could be used to consolidate the subsystems into complete farm systems.

HOW S.1128 CAN BE IMPROVED

Many of my reservations about S.1128 can be neutralized by major changes in Section 5, especially 5(a)(1) which specifies only twelve pilot research projects, and 5(a)(2) further specifying the number of farms of each class in sub-paragraphs A and B; also by changes in 5(b), which specifies twelve comparison farms which have already made the transition at least five years previously. I seriously question whether this strategy will lead to the most information and favor leaving the design of the study to some group of experts with credentials in experimental design and statistics and in other disciplines relevant to the study, and that the execution of the investigations be by similarly qualified sets of scientsists in the regions or states where the research has to be done.

This means that the pilot-demonstration nature of this research thrust may have to be abandoned and replaced with an experimental approach deemed to be most appropriate to respond to the expressed interest of Congress in this proposed legislation.

If a demonstration or pilot farm approach is considered essential, now or later, it should be provided for separately in this or subsequent legislation and made the responsibility of the U.S.D.A. Extension Service and the Cooperative Extension Services in the several states instead of the U.S.D.A. Agricultural Research Service and the State Experiment Stations which would do the research. Demonstrations and pilot farms are not the most efficient means of generating research information which can be used as a base for generalization to all farms. For the moment, however, I wonder whether the research base is adequate and summarized in a form to permit programming of alternative farming systems deviating very far from current general practices.

The length of time for study needs to be extended--preferably without limit within usual appropriation constraints. Not only is the five-year time limit too short to carry out the research as described and to meet the stated and implied goals, but new alternative technologies will continue to evolve, e.g., in integrated pest management, tillage, crop varieties, etc. and these will have to be introduced and adapted to the complete spectrum of farming systems because they may affect productivity in several systems and the effects might differ. It is in the national interest to continue the kind of agricultural research addressed in S.1128 even after five years. There should be no time limit on any kind of research, if we can afford it, especially as it pertains to sustained adequate food production, profitable to producers and readily available to consumers.

I believe that a new paragraph Sec. 5(c)(5) (D) needs to be inserted after line 19 on page 8 reading approximately as follows:

> "(D) design and execution of research conducted as specified in this Act shall be by certified professionals or scientists (e.g., agricultural engineers, agronomists, crop scientists, soil scientists, veterinarians, etc.) where appropriate and by currently active research scientists and administrators as evidenced by recent peer reviewed publication or other recognition by peers."

This will help assure competent research and interpretation in harmony with the scientific method.

All effective dates in sections 7, 12, and 13 should be delayed one year. Failure to do so would unnecessarily shorten the research period if a total time limit is maintained.

In Sec. 5(c)(5)(B) it is not enough to have a conservation plan approved and filed with the soil conservation district. To be at all effective, the plan must be at least partially and preferably fully implemented. Hence implementation must be a requirement.

Sec. 5(c)(5)(C): should the reference be to "paragraph (4)"?

Sec. 8 (a)(1): should the reference be to "section 5"?

OTHER OBSERVATIONS

It is my understanding that the United States Department of Agriculture and its cooperators already are doing at least some of

the things required in Sec. 4. For example, our department has undertaken the classification of all projects in the U.S.D.A.'s CRIS system as to relevance to alternative farming methods. This study is nearing completion. The Iowa State University held a conference on Biological Farming in 1983 and we have active research involving graduate students directed specifically toward the problems associated with alternative crop production systems The University of Nebraska is active in this arena as well and holds an annual tour of farms employing biological farming methods. Finally, we have had experiments with legume-based cropping systems in place continuously since 1917 and four major experiments currently have been in place about thirty years or more. Most of the experiment started in 1917 had to be given up because the land was lost to other uses, as have at least three other experiments, but two sets of plots from the 1917 experiment are still continuing.

The statement "...maintain high quantity and quality yields of agricultural commodities without relying on energy intensive agricultural practices; ...." in Sec. 3.(1) is quite misleading. An eminent ecologist reminded us that "there is no free lunch". If we are to keep our lunch relatively inexpensive, we shall require at least some minimum level of intensity in our agriculture; this shall require energy in some form whether it is animal, human, living or dead plants or fossil fuel. The economics and social infrastructure during the last few decades made substitution of the latter for part of the others feasible. This has not always been the case in general and may not be true in all cases today. Circumstances may alter the mix of energy sources in the future but will not remove the need for high energy input.

I challenge the statement in Sec. 2.(4), "energy intensive agricultural practices are needlessly dependent on limited global reserves of oil and natural gas, heightening the economic vulnerability of the United States agricultural system;" because:

1. We must devote more energy to the production, distribution and preparation of food and fiber today than when our population was smaller and when we exported little. As pointed out earlier the energy has to come from somewhere.

2. I am convinced we could not now maintain our standard of living and still produce enough food to meet our own population needs without dependence upon energy from off the farm. Whether we like it or not, it is so.

3. If we chose to do so, we could use coal (of which we have a large supply) to meet most of the off farm fuel needed. The technology to do so does exist or the processes are available when either the economics or the will exist to make this change.

4. Petroleum fuel consumption in the actual production of crops (including production inputs and harvesting) is a very small part of national fuel consumption. This part could be set aside to be filled only from domestic sources and the supply would be more than adequate. It is true that we have allowed our whole economy to depend upon off shore fuel sources. Thus all our economy is vulnerable--not only the "agricultural system". And removing the vulnerability of agriculture will not greatly affect the vulnerability of the rest of petroleum fuel consuming systems.

As an informed citizen and the product of a tenant farm (later my family purchased its own farm) I applaud the stated interest and determination to assist family farmers expressed in Sec.3.(2). I must add, however, that it has been general economic and agricultural policy which has led to difficulty for the small family farm, as I once knew it, and not our national research policy. Nor will research legislation, S.1128 included, rescue this family farm and we should not deceive ourselves in thinking and hoping it will.

RELATING S.1128 TO H.R. 2714

I find these two bills to be essentially the same. They do not differ substantially. Where they do differ, the H.R. 2714 is preferable. Because of the similarity, the concerns expressed about S.1128 apply also to H.R. 2714 but not as strongly to Sec.6.(a) and (b). However, even this section of H.R. 2714 needs to be reconsidered in light of my comments about S.1128.

I deeply appreciate having had this opportunity to make a contribution to these important deliberations.

STATEMENT OF WILLIAM LOCKERETZ
RESEARCH ASSOCIATE PROFESSOR
SCHOOL OF NUTRITION, TUFTS UNIVERSITY, MEDFORD, MA

Today's hearing is being held just about exactly one decade after research began in the United States on organic methods as a production system for commercial farms. I would like to summarize briefly the growing interest in the subject since then, an interest that makes the Agricultural Productivity Act timely and relevant.

When my colleagues and I began studying commercial organic farms in 1974 at Washington University St Louis, a substantial portion of the agricultural research community thought that the whole idea was pointless. A commonly held view was that one could not operate a full-scale farm as a commercially successful enterprise without using synthetic fertilizers and pesticides Moreover, since 1974 was a year of short grain supplies, unprecedented demand, and high crop prices it was generally thought that the future direction for agriculture lay in greater, not less, use of these materials.

Nevertheless, we found that organic farmers in the Midwest were doing quite well raising the major crops of the region, such as corn and soybeans, on a fully commercial scale. Moreover they reduced their farms' energy requirements by more than half compared to conventional methods. Shortly thereafter other studies undertaken at Land Grant schools in various parts of the country reached similar conclusions. (Washington University in contrast, is not a Land Grant school; the funds for that study came from the National Science Foundation By the end of the decade, organic farming had established itself as a legitimate research topic The limited work done by then was certainly not enough to know whether organic farming could compete dollar for dollar with conventional methods, but this is almost beside the point. What mattered was that organic farming clearly deserved to be taken seriously.

In the 1980s, interest in the subject has increased even more rapidly. A second round of sharp energy price increases in 1979-1980 reinforced earlier concerns about the energy requirements of U S. agriculture. Declining demand for U.S. grain and the resulting drop in grain prices has had a disastrous economic effect on farmers who had committed themselves to greater grain production The effects are less severe for the more diversified crop mix of organic farms. Moreover soil erosion remains a serious concern even though the Federal farm programs--whose costs have reached unprecedented levels--are supposed to enhance soi conservation as well as reduce grain surpluses Organic farmers, in contrast, use soil conserving crop rotations as an intrinsic part of their cropping system, without having to be paid to do so.

The USDA study of 1980 reflected the new interest in organic farming as a possible way of dealing with these concerns. Its findings were substantially the same as those of earlier studies, but the study was more comprehensive and received far wider recognition Moreover, it had impeccable legitimacy It did not escape attention of the research community that a study that presented organic farming in a highly favorable light came from an agency that previously had displayed no noticeable interest in the subject, and certainly not any favorable interest.

So too with the American Society of Agronomy, which in 1981

devoted a full day symposium to organic farming at its annual meeting. This symposium, which was extremely well attended, featured papers by about a dozen American agricultural scientists from around the country, most of whom would rank among the outstanding names in the field. In addition, there were several papers by prominent Europeans. The 1981 symposium was the most prestigious and comprehensive gathering on the subject ever held in this country.

Two later conferences are worth mentioning as an indication of the growing level of interest in organic farming among agricultural researchers. In 1982, the International Federation of Organic Agriculture Movements (IFOAM) held its fourth biennial research conference at the Massachusetts Institute of Technology Some 45 papers were presented, about two-thirds of which were from the United States, the remaindar from eight countries around the world. Over half of the U.S. speakers were from the USDA or the Land Grant system, with the Northeast, Southeast, Midwest, and Pacific Coast all represented. The fifth IFOAM conference, which takes place in Germany this August, will be even bigger, with ovar 80 speakers scheduled.

Finally, a conference entitled "Sustainable Agriculture and Integrated Farming Systems" was held this very week at Michigan State University. The themes of this conference were virtually identical to those spelled out in Section 2 of the Agricultural Productivity Act The speakers included most of the leading organic farming researchers of the United States and Europe. I have just come from that conference where I presented a paper that reviewed on-farm organic agriculture research in the United States during the past several years.

In going over this research, I was struck by the much more widespread interest in organic farming compared to the 1970s, when just a few projects were underway The research I reviewed was done in many parts of the country and involved various kinds of farms. Moreover, the subject was investigated from many perspectives including economics, sociology soil science, and ecology But at the same time, it was clear that minimal resources were available to the researchers. Typically organic farming research has been done as a thesis project for a Masters degree student which means that only one or at most two years of data can be collected, and that the work is restricted to at most a few sites. Such a limited effort can hardly do justice to this complex subject, even if the investigators are highly competent and dedicated.

Thus there is a clear discrepancy between what agricultural researchers think should be done and what they actually can do under current conditions. The increasing number of projects on organic farming demonstrates clearly that the topic has been recognized as an important and timely one. On the other hand, just thinking that a topic should be studied is not enough; unfortunately, so far the wherewithal do an adequate job simply has not been there. The Agricultural Productivity Act will correct this imbalance by establishing a solid coherent and adequately funded program in an area that can have important benefits for America s farmers. These benefits will begin to be achieved even in this decade but will be especially significant in the longer run as greater resource pressures are placed on our agricultural system.

[The following review was furnished by Dr. Lockeretz, see p. 98 for oral reference:]

[Reprint from New Land Review, Spring 1981]

Organic and Conventional Farming Compared: Different Script, Same Old CAST

(By William Lockeretz)

Whatever else you might say about the Council for Agricultural Science and Technology (CAST), at least it's consistent. Since its creation in the early 1970's, this increasingly controversial association of 25 professional agricultural societies has consistently favored capital intensive, high technology farming, systematically touted its advantages, downplayed its disadvantages, and predicted dire consequences for its alternatives. The latest CAST effort, "Organic and Conventional Farming Compared" (Report No. 84, Ames, Iowa, October, 1980, 32 pp.), is no exception.

CAST formed its task force on organic farming in 1978, choosing as chairman University of Illinois agronomist Samuel Aldrich, who had written several articles strongly critical of organic farming. The report is exactly what one would predict, a onesided and distorted hatchet job that conveniently ignores the growing body of scientific research on organic farming methods. Compared to the balanced and intelligent material coming from other sources recently, such as the USDA's study team on organic farming, this report hardly seems worth commenting on. But CAST is still very prestigious in certain circles, and its reports are sent to Congress, USDA, and the media. Unfortunately, the latest report's many defects may not be apparent to all readers, and it could receive far more attention than it deserves.

It is hard to know where to begin criticizing the CAST report. Part of the problem is that the report shoots at a constantly moving target. But it's the authors themselves who are moving the target around.

Very little of the report is actually about the stated topic—at least about those aspects of the organic-conventional comparison that are most significant, like differences in production practices, resource use, and crop yields. Instead, the authors spend a good deal of time refuting the misconceptions supposedly held by proponents of organic farming. The implication presumably is that a system practiced by such unscientific people could hardly be a valid one. (I've known conventional farmers with some pretty wild views, but I've never seen such views brought up in CAST's or anyone else's analysis of conventional farming systems.)

For example, they discuss at considerable length the fact that "some chemicals produced by certain living things are toxic to other living things," by way of countering organic farming proponents' alleged ignorance on this point. (They do not ask why some organic farmers purchase natural insecticides if they think that such chemicals can't be toxic to anything, like insects, for example.)

Even when the report deals with more relevant and tangible questions, like production techniques, it avoids the main components of organic farming as actually practiced. Again and again, the authors present what seem to be impressive arguments against organic farming in certain highly specialized situations, or against the worst possible version of organic farming, or against methods that have nothing to do with organic farming. And of course, they invariably fail to point out any of these limitations.

Thus we are told why herbicides are essential for producing small seeded crops like carrots, but we are not informed that less than 5% of herbicide use is for all vegetable and fruit crops combined. Even if the argument is valid for commercial carrot production (and it may not be), the reader might not realize that it is not at all relevant to more than 95% of herbicide use.

Similarly, we learn that handweeding the U.S. corn crop would require 17.7 million people working 40 hours per week, but we are not told that organic corn producers don't use weeding. And CAST even trots out the old one about how many acres (180 million) would be required to feed all the horses if we returned to animal power, conveniently ignoring data showing that organic farms are as mechanized as conventional farms. Indeed, they have not left out any of the familiar non-arguments so often offered as substitution for relevant data in attacks on organic farming.

One difference between this report and previous examples of its type, however, is that we now do have some real data about organic farming as it is actually practiced. The report's treatment of this material is remarkably brief in comparison to the space devoted to speculation, irrelevancies, and semantic quibbling. But even

more important, the studies that were cited apparently had little influence on the conclusions reached by the report.

For example, the report states that organic farmers depend on premium prices for their products, even though one of the cited papers—which was based on a large-scale survey of the marketing practices of commercial organic farmers—found that premiums are not very common for major products like beef and grain.

It is hard to understand how 24 agricultural scientists with such strong professional credentials could produce such a report, or even allow their names to be associated with it. (However, the final content of CAST reports is determined largely by the task force chairman and the Excecutive Vice President of CAST, and does not necessarily reflect the views of every task force member.) Part of the problem lies in how the job was done, part in who was chosen to do it.

Collecting new empirical data was beyond the scope of the task force. One might expect, therefore, that at least the group would have tried to have some first-hand contact with some people who had some involvement with organic farming. For example, the USDA study team visited many organic farms, consulted with staff members of organic farming publications and organizations, and attended conferences on the subject. CAST did not, and the difference shows.

The USDA group clearly knows what organic farming is all about—what kind of people practice it, what they do, and why they do it. The CAST authors seem to be viewing the subject from a great distance. They talk about what they have heard organic farming is, what they speculate it might be, what is convenient for them to define it to be. But they hardly talk about what it actually is.

Viewing the subject from such a distance might have worked if the authors had had a strong previous familiarity with the topic. Many members of the CAST task force do have impressive backgrounds in topics related to organic farming, like manuring or integrated pest management. But with one exception, I am not aware of a single member of the task force actually having conducted research on organic farming as such.

The exception is an interesting one. He is a rural sociologist from Cornell. Initially, the Rural Sociological Society (RSS) had no representatives on the task force, even though the report was supposed to cover the socioeconomic implications of organic farming. Some RSS members were becoming increasingly discontent with their omission from CAST task forces, even giving serious consideration to withdrawing their organization from CAST. At RSS's insistence, the Cornell sociologist and a former RSS president were added to the group.

The two made a strong effort to improve the original draft by eliminating its distortions, fallacies, and biases. They succeeded only in correcting certain flagrant errors. The basic content of the final version is not very different, but it has a much more polished appearance as a result of the professional editing. Given the sincerity with which the two rural sociologists undertook their futile effort, I am reluctant to say this, but I think it would have been better if they had withdrawn when they realized what they were up against. (I am also a little sorry that the final version's discussion of the limitations of integrated pest management doesn't have the reference to Ranger Rick's Nature Magazine.)

Until a few years ago, organic farming was fair game for its critics. Anyone could take a cheap shot at the handful of kooks or dreamers who thought there was anything to it. But the rules have changed. There is a small but growing body of research on organic farming that attempts to meet the same scientific standards that would apply in any area of agriculture. While this work is hardly definitive, at least it has established the subject as one that is entitled to serious, careful examination. These days, something like the CAST report really doesn't have that much to contribute.

STATEMENT OF ERIK JANSSON
RESEARCH ASSOCIATE FOR PESTICIDES
FRIENDS OF THE EARTH

EXECUTIVE SUMMARY

Passage of the Agricultural Productivity Act should be only a first step towards reorganization of USDA towards a greater emphasis on cost control in farming. USDA does not presently treat farming as a business, with revenues and costs, and should if we are going to have any prosperity in the farm community in the future.

We will know that USDA has changed its approach when the Department creates an Office of Farm Cost Control within the Department, and puts research resources into this subject.

Presently, organic farming is a speciality crop, a $2.2 billion industry sold out of 6,800 store outlets. It has a major foreign export market. At the last whole food fair in Anaheim, California there were between 70 and 200 foreign buyers, 40 of whom were Japanese. In Japan, organic food has a larger market than in the United States.

But, being a specialty crop is not the future. Rather we see the future of organic farming being a mainline approach to reducing costs in farming. It is a systems approach to cost control on the farm, and it works well as such. Lockeretz found, for example, that costs of production per acre on mid-West organic farms were reduced by 34 percent over conventional farms, and that these farmers made just as much money as the conventional farmer and more so in bad weather years.

Indeed, the American farm lends itself to this type of systems cost reduction approach. Today, for example, 50 percent of all farm sales are animals and animal products. Integration of this part of the farm operation into the crop portion of the farm needs attention from a business viewpoint.

Secondly, 25 percent of American farm sales are to foreign buyers. Yet, with the American dollar so high relative to foreign currencies, American farmers are beginning to lose markets abroad, just as they did in the 1920's - a similar economic time. The solution to this problem is to give American farmers ways to reduce farm production costs, so that they can continue to compete with the price of foreign producers despite the high dollar.

In summary, we hope that the Congress and this Committee will pass the Agricultural Productivity Act, which looks at systems research into farm cost reduction. But, we hope that you will go beyond this and insist that USDA establish an Office of Farm Cost Reduction as an important focus for future USDA programs. The time has come to treat the American farm as a business with both revenues and costs if we want our farmers to stay in business and if we want to keep our farm export markets.

CHART 1. WITHOUT THE AVAILABILITY OF COST REDUCTION SYSTEMS LIKE ORGANIC FARMING, AMERICAN FARMERS ARE VULNERABLE TO A SUBSTANTIAL ECONOMIC SQUEEZE AS IN THE 1920'S

The sharp increase in exports of American farm products began when President Nixon devalued the American dollar on August 15, 1971. The sharp increase in the value of the dollar due to the new economic programs begun in 1981, has already caused a decrease in farm exports from the United States and is a beginning of a squeeze on profitability of American farming that can only presently be addressed by cost-reduction measures on the farm.

As in the 1920's, the loss of profitability due to an export squeeze tends to produce a self-reinforcing trend, because land prices upon which loan collateral was based, tend to fall.

Daniel Zwerdling notes the four assumptions of farmers made in the 1970's, which could lead to spiralling bankrupcy in the future.

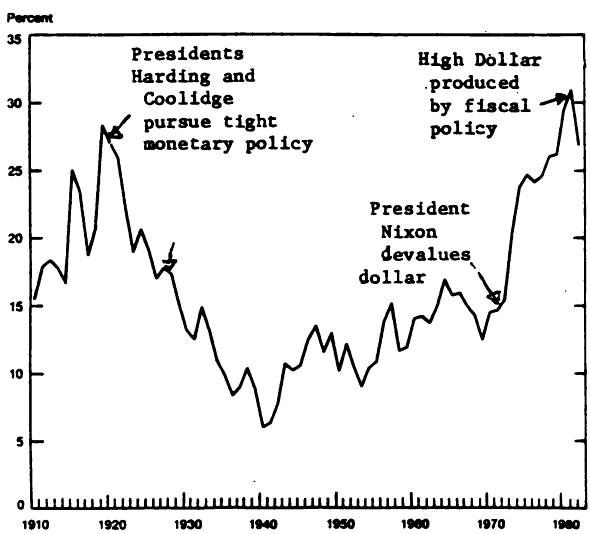
Assumption 1: World demand for American crops was insatiable, and farmers could sell all the crops they could grow.

Assumption 2: Land prices would keep rising.

Assumption 3. The cost of borrowing money would keep lagging behind.

Assumption 4. The costs of high-technology farming would stay about the same while crop yields and farm profits would keep rising.

Agricultural Exports as Percent of Farm Cash Receipts



Source: Department of Agriculture.

A Focus on Cost-Reduction in Farming

Friends of the Earth is an environmental lobby group with approximately 28,000 members in the United States and membership in every state. We have sister organizations in 24 foreign nations.

Even though we are an environmental group, this presentation is not going to focus on some issues that you might expect from us. Others will tell you that there are 6,800 health food and organic food stores in the United States, a $2.2 billion specialty business. Others will focus on the idea that farmers make more money selling to specialty businesses. Others will tell you that there are between 20,000 and 22,000 organic farmers and additional 10,000 large gardeners in the United States with sales of $100 million. Others will focus on the obvious health benefits of less pesticides in the food, the obvious environmental benefits of having less pesticides in the

environment, and finally, that soil conservation with some of the biological farming techniques are less expensive for the farmer.

Instead, we want to look at the economics of American agriculture and make an ANALYSIS OF WHY COST-REDUCTION through organic farming methods make sense, and why the Congress and this Committee should focus upon cost-reduction as an important approach towards greater prosperity in American farming in general.

NEED TO TREAT AMERICAN FARMING AS A BUSINESS: COST -REDUCTION

Friends of the Earth favors the Agricultural Productivity Act farm research program because of its potential for cost reduction in farming. Unlike many agricultural research program, this program favors a systems approach to costs in farming rather than a piecemeal approach. Clearly, a systems approach to farm costs is needed.

Today, the profitability of farming is low because costs are high and rising, and because prices are low. In 1982, farm expenses exceeded farm revenues for the first time in history. This lack of prosperity has been expensive for the federal government which in fiscal 1983, outlayed $28 billion for farm price and income supports and for PIK payments.

The Department of Agriculture has never been willing to treat farming as a business with both revenues and business costs. We are worried about USDA, and wonder why they oppose a systems analysis on farm costs when such a wide coalition supports the Agricultural Productivity Act. We are worried about the farmer and wonder how they are going to stay in business if USDA does not become interested in ways to compete better with lower production costs.

The recent report of the President's Council of Economic Advisors, Economic Report of the President, submitted to the Congress in February 1984, noted the high costs of farming today, that the farm economy is locked as never before into the economy and into the export market and that federal payments to the farming community had reached unstainable levels.

INDIANA FARMERS AND POSSIBLE FUTURES

With American farmers losing competitive advantage in world markets because of the high dollar, inattention to cost reduction in farming to enable farmers to be more competitive can lead to severe economic stress.

Daniel Zwerdling in late 1983, interviewed Indiana farmers, farm supply managers, and bankers. He found a consensus from these Indiana producers that "America's farmers are only one bad season away from a collapse comparable to the Great Depression." What they are talking about is about one quarter of farmers going bankrupt in a short period of time.

He proposed cost-reduction in farming as a solution, noting that the proposals you are least likely to hear from the Department of Agriculture may be the only ones that can save American agriculture "Farmers must use the least expensive least energy-intensive methods of growing corn. And they must produce only as much bushels per acre as the soil can support while still sustaining or even increasing its productivity "

Such a program would also offer a lot more flexibility to the federal government, which has been locked into huge subsidy payments to keep the farmer solvent. The challenge of the next years is not to produce a greater quantity of grain and other produce. We already

know that the American farmer is capable of swamping the markets with excess production. Instead, the challenge will be to sell the enormous surplus production in world markets in competition to foreign producers which now have a lower cost structure because of the high price of the dollar. We will look at this issue in more detail later.

Imagine with us, for example, a PIK program which paid farmers to go organic rather than to take cropland out of production. Such a program would:

1. meet the objective of reducing the production of surplus produce wanted by the federal government, at least until research developed comparable yields. For example, Lockeretz's study found that organic farms in the mid-West achieved yields that were 89 percent of the conventional farmers.

2. reduce the cost of production sharply so that the product produced could compete in foreign markets better. The study by Lockeretz found that operating expenses of organic commercial farms in the mid-West were 66 percent of that of the conventional farm.

3. permit the participating farmers to make a lot more money. The Lockeretz study showed that organic farmers in the mid-West were just as profitable as conventional farms, and more so in drought years. If we added PIK payments to this, such farmers would make dramatically high profits than a PIK farmer who set aside his acreage in the conventional way.

If you think that this possibility is just imaginary, we want to point out that Friends of the Earth suggested such a program to the Department of Agriculture when Anson Bertrand was still director of the economic division. They thought it was a good idea and took it seriously.

If we look at the structure of American agriculture today, it becomes clear that failure to look at a cost reduction system as envisaged in the Agricultural Productivity Act will entail expensive results for both the American farmer and the budget of the federal government.

THE STRUCTURE OF AMERICAN FARMING AND THE POTENTIALS OF BIOLOGICAL FARMING

The present orientation of American farming towards animal products and towards the export market makes research into biological farming systems an obvious program for USDA. American farming is:

1. Heavily oriented towards animal products: 50 percent of sales

In 1982, about half of all farm cash receipts in the United States came from animal products. The largest components were beef cattle and dairy products making up 21 and 13 percent respectively of the total, followed by hogs with 7 percent, and chickens and eggs each with 3 percent of the total. In addition, 16 percent of crop sales went to feed livestock, and 35 to 40 percent of on-farm production of corn is fed to livestock.

The present orientation of American farming towards animal products lends itself towards a traditional type of organic farming that integrates the crop and non-crop portion of the farm into a system. Intercropping with legumes is a second type of organic farming- again a systems approach

that reduces farm costs.

In a farm economy so heavily oriented to animal products, one would expect that the USDA would be interested in the subject of integration of the animal and crop portions of the farm.- since there is greater profitability here.

2. Heavily oriented to exports: 25 percent of sales

Beginning with the devaluation of the dollar in 1971 by President Nixon, American farm exports have soared to the point where exports now account for about one quarter of all farm sales. This peak approximates that of the 1920's, and represents 35 percent of all harvested cropland in the United States. (See Chart 1.)

Unfortunately, the sharp rise in the value of the dollar under the economic policies pursued in the past few years has undercut the competitive position of American farmers. To counter the effects of a high dollar, there are only two real solutions:

a. The federal government can subsidize exports - an expensive program;

b. USDA can develop cost-reduction methods for the farmer like organic farming to permit farmers to meet the competition of foreign producers without going bankrupt.

Along these lines, in the last Whole Food Trade Show in Anaheim, California in March, between 70 and 200 foreign buyers showed up, including 40 buyers from Japan. Japan is a much larger market for organic food than the United States presently - a specialty market that could be important for many western farmers.

THE DEPARTMENT OF AGRICULTURE'S FIGHT AGAINST LOW COST AGRICULTURE - NEED FOR AN OFFICE OF COST REDUCTION

USDA has a long tradition of opposition and resistance to farming methods that could reduce input costs on the farm, and help the farmer stay in business.

A good example of this is the lack of enthusiasm of USDA about integrated pest management (IPM), a farm method that is known to save 50 to 80 percent of the costs of managing farm pests. The idea that the farm is a business and should be treated as such- with both a cost and revenue side- appears to have escaped USDA.

In 1977, Secretary Bob Bergland signed Memorandum 1929, which made integrated pest management a primary goal of the Department of Agriculture. This was followed by the Executive Order of President Carter in 1980, making IPM a program for all federal agencies, following the enthusiasm of President Richard Nixon for the program.

There was resistance to these memorandums, which remains unabated at USDA to this day. For example, a report published in February 1981, by the U.S. Forest Service found that a large percentage of field staff of the Forest Service drew a complete blank, when asked whether they use integrated pest management. "What is that", they ask.

Five years ago, Friends of the Earth and the American Agriculture rement jointly testified before the House and Senate Appropriation

Committees in a successful effort to interest the Congress in investing $5 million a year for the IPM research program coordinated by Texas A&M. As USDA presently is opposed to raising funds for organic farming research to give the American farmer a break on his costs so then in 1977, USDA opposed raising funds for IPM research. The same arguments were used then as now- that research into cost reduction methods for the farmer were redundant because USDA was already doing this. Of course, it is quite clear that USDA is not providing such research.

Need For An Office Of Cost Reduction At USDA

Considering the precarious situation of farmers today, we would like to urge the Congress and this Committee not only to vote for the Agricultural Productivity Act, but also to restructure the Department of Agriculture so that it has an Office of Farm Cost Reduction.

USDA today appears to be one of the few federal agencies regulating business that disagrees with the majority of American businessmen that cost control is one important element in business profitability.

ORGANIC FARMING OFFERS WIDE OPPORTUNITIES FOR COST REDUCTION

Research into cost reducton systems in farming is a proper role of USDA. The long growing season, low profits, and high risk of farming has always made it impossible for farmers to undertake the research and development necessary to protect the national interest.

Organic farming or biological farming is a system that looks at a much wider range of cost-cutting measures than has been the standard. It is quite obvious that there is much room to drop costs in agriculture, and make American farmers more competitive in selling their products in the world market.

Note the following:

1. Profitability of Organic Farming Seen As a Whole:

The 1981 study of Lockeretz and others of mid-west organic farms found a 34 percent reduction in costs per acre, compared to equivalent conventional farms. Value of production did fall by 11 percent but profits per acre were vitually the same for organic farms, and better in dry years and years of bad weather conditions.

The slight loss of yield in these traditional organic farm systems is actually attractive for the nation and for the federal government If every farmer lost just a little yield, this would be just as effective as cropland set-asides in achieving the lower production actually sought by the federal government As already noted, we proposed such a program to Anson Bertrand s office in 1980, at USDA, and they found it quite interesting and attractive.

It is obvious that hybrid systems can be developed to raise yields in organic farmings - such as the legume overseeding program described in Table 1. No yields were lost here, but costs were reduced substantially for the farmer.

2. Fertilizers:

We know that farmers even without the use of organic systems can sharply reduce the use of fertilizers, and get the same yield.

The Rodale Experimental Farm of Pennsylvania in 1982, found that most soil testing companies made recommendations for excessive

use of fertilizers - that is fertilizer applications that produced no additional yield and just wasted the farmer's money. Government facilities had a spotty record in their soil testing recommendations.

For example, the University of Nebraska Agronomy Department sent samples of the same soil to five different laboratories. At Mead, where the research as been going on the longest, the five soil testing laboratories working from soil samples form the same field recommended a range of 115 to 270 pounds of nitrogen fertilizer per acre for the same yield goal, during the eight years from 1973 to 1980. Using their recommendations, the corn yields during the same eight year period were only 5 bushels per acre apart.

The least expensive fertilizer program outproduced the most expensive by an average of 3.6 bushels per acre per year. Soil testing Lab C had the most expensive program - recommending $77 per acre of fertilizer applications, compared with an average recommendation of $35 per acre per year of soil testing Lab E.

It is fair to say that a $32 per acre difference in fertilizer costs per year without gain in yield would be sufficient to force many farmers into bankrupcy.

3. Intercropping With Legumes:

Intercropping of row crops like corn with nitrogen producing clover and other legumes has been shown to cut fertilizer costs and suppress weeds without loss of yield.

Table 1 shows the result of overseading tests with legumes in corn. Note the lack of loss of yield. Farmers would find it impossible to get information on how to run such systems from USDA at the present time.

Table 1

Intercropping With Legumes Does Not Reduce Corn Yields, Competes with Weeds, and Also Provides Free Nitrogen

Effect of Overseeding Legume Cover Crops on Corn Yield and Weed Stand, 1981

Time of overseeding	Legume species	Grain yield (tons/ha)	Weed reduction[a] (%)
35 DAP[b]	Medium red clover	7.30	76
	Hairy vetch	7.13	72
	Control (no overseeding)	7.49	—
47 DAP[c]	Medium red clover	6.96	40
	Hairy vetch	7.35	27
	Control (no overseeding)	7.13	—

[a]The legume overseeding resulted in an average of 95 percent ground cover for both species.

[b]DAP, days after planting corn, one cultivation prior to overseeding.

[c]DAP, days after planting corn, two cultivations prior to overseeding.

From Lockeretz, William, Environmentally Sound Agriculture. Praeger: N.Y. (1983)

4. Biological Control of Pests:

Another aspect of biological farming is the use of counter-pests and natural controls in place of expensive pesticides.

USDA's past and present programs demonstrate that biological control of pests saves a lot of money. A good example is the control of the Mexican bean beetle in Maryland and Delaware with aerial drops of parasitic wasps In 1977, it was estimated that for a cost of $50,000 per year by USDA, the soybean farmers of the region were saving between $1 to $3 million per year.

The author's parents run a family farm in Maryland. For the past five years, they have essentially grown "organic tobacco", using bacillus thuringiensis for caterpillar control and ladybugs for aphid control. No sprays have been necessary for five years beyond this. Because the local extension agent said that a biological control program for tobacco was "impossible", the program was designed by a private forest consultant.

Another good example is the use by the Irvine Ranch of parasitic flies and killer snails to control citrus pests. They believe that they are saving money, since pest control costs have remained stable in an inflationary period.

5. No-Tillage Agriculture Organically:

Organic farm systems are known to prevent soil erosion at lower costs than the expensive no-till systems promoted by USDA. No-till is not really a good money saver for the farmer, compared to conventional farm systems Indeed after substantial USDA promotion of no-till, only 3 percent of American farms use the system because it is not inexpensive.

There is a lot of room for cost savings in soil erosion control on the farm, but I can guarantee that you cannot get a straight answer from the Extension Service or from USDA headquarters on how to save money and still get results.

A number of farmers have shown that organic no-till agriculture is entirely possible - achieving the same program promoted by USDA with a much lower cost.

6. Fertilizer Poundage Related to Crop Quality:

Applying more fertilizer is not necessarily beneficial to yields, and certainly not to crop quality. In tobacco, for example, it is well documented that excessive nitrogen fertilizer application can damage the crop, since proper curing becomes impossible. A farmer who applies too much nitrogen fertilizer will receive a lower price per pound.

Recent European studies show that similar effects can occur in other cash crops. For example, excessive nitrogen application to apples does increase yield, but in the process damages storage quality and taste and color. Similar findings are reported for potatoes and vegetable. Increased insect damage can also occur from excessive fertilizer use.

In Austria, excessive application of chemical fertilizers to pastures has been found to result in an increase in infertility and decrease of semen quality in bulls. It was suggested that an imbalance of plant aestrogenes in the fodder could be a cause.

One has to go to Europe to get information on an issue like this- very relevant to farm profits - because USDA has not been interested in farm cost reduction.

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STATEMENT OF
F. KAID BENFIELD, SENIOR STAFF ATTORNEY AND
JUSTIN R. WARD, AGRICULTURE PROJECT ASSISTANT
NATURAL RESOURCES DEFENSE COUNCIL, INC.

The Natural Resources Defense Council, Inc. (NRDC)*/ is pleased to register its strong support for S. 1128, the Senate companion to H.R. 2714, the House-passed "Agricultural Productivity Act of 1983." The bipartisan backing of this legislation in both houses of Congress, combined with the impressive array of supporting individuals and organizations, testify amply to its merit.

In essence, this bill can be regarded as a research and assistance measure which calls for the badly needed development of more complete information on promising farm techniques in the face of a range of challenges to the viability and sustainability of modern agriculture. By seeking to improve upon our imperfect understanding of issues like energy availability and the hazards of pesticides and herbicides, the research program contained in the bill represents a prudent course of action and, in a fundamental sense, a sort of insurance policy for the future. Our statement will briefly address the conceptual and practical advantages of the bill and answer the few objections that have been raised against it.

As to advantages, the proposal is predicated on the welcome recognition that desirable farmer and social objectives need not be mutually exclusive. For instance, the stated purpose of the Act (Section 3(1)) is to simultaneously promote increased productivity, environmental conservation, and cost-effectiveness. This thoughtful premise challenges traditional assumptions about trade-offs among competing goals, and we commend it heartily.

In addition, the proposed research program in S. 1128 is wisely designed to encourage the development and integration of environmentally superior farming practices into the existing framework of modern agricultural technologies -- a preferable and practical option to offering them as comprehensive substitutes for systems already in place. Through pilot research, the Act contemplates an examination of the effects of a measured transition from chemical-intensive farm practices to regenerative farming based upon naturally productive techniques such as crop rotation and the use of manure. The proposed legislation in no way advocates an across-the-board replacement of existing systems.

The benefits of such techniques are well identified in the U.S. Department of Agriculture (USDA) "Report and Recommendations on Organic Farming." That July 1980 study addressed various issues of concern to NRDC including topsoil loss, declining soil productivity, and environmental degradation with accompanying human health risks from pesticide use -- topics which were further discussed in the 1980 USDA appraisal of resource conditions and trends conducted under the Soil and Water Resources Conservation Act (RCA).

The major operative provisions of the bill are sound. The contemplated information study (Section 4) would provide a

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*/ NRDC is a nonprofit corporation with more than 40,000 members and contributors, dedicated to the preservation, enhancement, and defense of the natural resources of the United States and the world. Through the efforts of its agriculture project, NRDC supports the maintenance and improvement of the productive capacity and soils of our nation's valuable agricultural lands as well as the protection of environmental quality and human health.

mechanism for systematically taking stock of what is currently known about organic farming techniques. This study would also be useful as a means of identifying gaps in scientific knowledge and thereby focusing future research. The pilot research projects (Section 5) would serve as a valuable supplement to the existing research identified in the information study. The intercropping assistance provision (Section 10) would clarify that, for the purposes of federal conservation aid, farmers who utilize this highly beneficial technique to reduce erosion and promote soil fertility are on an equal footing with those who utilize other methods of conservation.

We believe S. 1128 is a well-conceived, reasonable measure which should not in any sense be controversial. Nevertheless, there has been some opposition to this legislation; in particular, three basic objections that have surfaced during the process deserve rebuttal.

First, the claim that the research program embodied in S. 1128 is duplicative of existing work is simply untrue. No federally sponsored research currently involves the sort of case-study approach (as called for in the bill) needed to rigorously examine entire farming systems. The lack of agency involvement in regenerative farming research was underscored in Congressional testimony last summer by William Kruesi, a County Extension Agent from Vermont who told a House Agriculture subcommittee: "The first obstacle to educating farmers about alternative agricultural techniques is a lack of recognition and support by the Extension Service, Department of Agriculture, and the farm supply industry. From Extension, there is almost no technical information which emphasizes cultural and biological control of insects, pests and diseases."

Second, the contention that the bill's provisions unreasonably constrain research design is unfounded. The bill allows abundant flexibility in this regard, especially in Section 6 ("Coordination"), which provides that an appointed inter-agency advisory council shall participate in the design of the 5-year pilot on-farm studies. Moreover, although the sample size for the pilot research is small and the requisite time periods for the studies short, there is little doubt that, provided the experiments are conducted scientifically in consultation with a variety of experts, valid and useful statistical results can be obtained.

Finally, contrary to suggestions made by opponents of S. 1128, the bill is not inordinately expensive; it constitutes a rather modest approach to a complex and challenging problem. Indeed, the proposed funding allocation of $2.1 million annually for 5 years represents only a tiny fraction of the overall USDA research budget and would not drain money devoted to other vital USDA research needs. As Senator Leahy stated in his introductory remarks, "the costs of this effort would be minimal and the benefits to American agriculture, the consumer, and the environment would be substantial." Moreover, the funding authorized by S. 1128 is absolutely necessary to carry out the [January] 1983 recommendations of the Agricultural Research Service, in its proposed 6-year program, on the development of superior farm technologies.

In sum, the Act would simply assist USDA in fulfilling its basic responsibility to provide support to American farmers. It is clearly a necessary and proper function of the Department to serve as a catalyst for the development of, and a clearinghouse for information about, cost-effective, conservation-oriented agricultural techniques. The bill is a sensitive and constructive response to the problems facing American farmers today.

STATEMENT OF CLINTON RAY MILLER

LEGISLATIVE ADVOCATE OF THE
NATIONAL HEALTH FEDERATION

Mr. Chairman and distinguished members of the Subcommittee:

I am pleased to appear before you in strong support of S. 1128/H.R. 2714.

My name is Clinton Ray Miller. I have represented the National Health Federation for the past 23 years as its Health Freedom Legislative Advocate.

We believe that RESPONSIBLE, informed health freedom is as important as religious and political freedom and that these three freedoms are interdependent. We can't have one without the other.

The National Health Federation (NHF) publishes a monthly journal called the Health Freedom News and holds educative seminars and conventions for our 17,000 members and their friends in major cities throughout the United States.

Because we support and defend health freedom we open our conventions and journal to new and sometimes unorthodox opinions and theories by scientists and lay people concerning the least expensive, safest, and best ways to obtain or regain health.

SOIL FERTILITY AND HUMAN HEALTH

Over the past 28 years we have had several individuals speak at our NHF conventions defending their sincerely held beliefs and theories that the nutritional value of plants is directly related to the fertility of the soil on which they are grown. What is more important, they have argued convincingly that the health, vitality, and longevity of U.S. citizens is directly related to soil fertility. Devitalized soil, they claim, has resulted in a far less healthy population than we would have been if all our foods were grown on fertile soils.

If this is true, it is one of the most important but least understood truths in the world today. It is certainly one of the most controversial theories around.

The intensity and intolerance of those who debunk the theory is matched only by the equal zeal and enthusiasm of those who believe in it.

On the debunking side we have Harvard University represented by Dr. Frederick Stare, M.D., Professor of Nutrition. For more than 20 years he has pontificated that it is a great myth that soil depletion causes malnutrition and disease.

Dr. Stare's deeply biased beliefs are repeated as though they were fully researched scientific facts by the U.S. Food

and Drug Administration, the U.S. Postal Service, the Federal Trade Commission, the American Medical Association, and even the Arthritis Foundation. However, to its credit, the United States Department of Agriculture does not share this belief.

S. 1128 WILL INDIRECTLY INCREASE CURIOSITY AND RESEARCH ON THIS DEBATE

Although there is nothing in the language of S. 1128 which states that it will directly authorize research linking soil fertility to human health, it is easy to predict that when enacted, the new research will stimulate much more important research on the link between human health and soil fertility.

A hint of the link was reported in a clinical note in The American Journal Of Proctology, (Vol. 12, No. 1) February, 1961, pp. 36, 37 (See Exhibit #1)

You will note that this was reported more than two decades ago in 1961 in a prestigeous medical journal. To my knowledge, not a single experiment has been conducted by the USDA, FDA, the National Cancer Institute or any other governmental agency to see if the "marvelous phenomenon" reported by Dr. Collins could be repeated again under controlled conditions.

S. 1128/H.R. 2714 directs the USDA to inventory and assess existing research and extension materials, and to recommend new research, that will help farmers achieve a better understanding of the ramifications of innovative farming practices. We would naturally expect one of those recommendations to be for research on the link between soil fertility and human health.

There are those who will ridicule the possibility that there could possibly be any link between soil fertility, pesticides, herbicides, and cancer.

In the National Health Federation we don't ridicule or defend health theories. We defend the right of those who have new ideas about old unsolved health problems to bring them forth for debate, criticism, and additional research. Until we have the answer to cancer "the jury is still out."

IS ANEMIA RELATED TO SOIL FERTILITY

Anemia is one disease which may be more easily proved to be related to soil fertility than cancer.

Exhibit #2 is a chart of the extremely wide variations discovered in the mineral content in vegetables grown on different soils.

Note, for example, that tomatoes grown on one soil have 1 part per million of iron compared to tomatoes with 1,938 parts per million of iron when grown on different soil.

One way to emphasize the fantastic difference of iron content in tomatoes grown on different soil is to realize that an anemic girl or woman would have to eat a tomatoe a day for more than 5 years that contained 1 part per million (ppm) of iron to equal the iron she would get in a single tomatoe that contained 1,938 ppm.

Is anemia a problem in America?

It is a tragic problem of immense proportions that might be virtually eliminated by simply increasing the fertility of the soil on which tomatoes and other vegetables are grown.

Exhibit #3 is taken from the Preliminary Report #3 of a Nationwide Food Consumption Survey, taken in 1977-78 and published January 1981 by the USDA.

It reports that more than 10% of the U.S. households are consuming food that provide less than the recommended dietary allowance for iron.

More research is urgently needed to see if this problem can be corrected by increasing the iron content in vegetables by improving soil fertility.

There may be a link between many other chronic diseases and the fertility of the soil on which our food is produced.

The NHF urges enactment of S. 1128/H.R. 2714 to the end that this research will be done as soon as possible.

(EXHIBIT #1) p. 1

CLINICAL NOTE:

Anti-Malignancy Factors Apparently Present In Organically Grown Foods

DONALD C. COLLINS, M.D. FIAP
Hollywood, California

This clinical note is written with considerable hesitancy, and yet on five different occasions during the past thirty-six years of practice. I have seen a marvelous phenomenon occur.

Five patients have been observed with extensive malignancies, proven by biopsies, of either the gastrointestinal tract, or blood (leukemias), or sarcomas. Strangely, these five individuals all died many years later from diseases unrelated to these former malignant processes. It was shown in all five instances, following most thorough and painstaking autopsies, performed by highly competent pathologists, that no discernible pathologic evidence could be found then that such patients had ever previously had the various malignant diseases, proven by adequate biopsies to have been present in the past.

The only constant factor in the lives of these five persons was the fact that they all ate home raised, organically grown foods that were free from various chemical preservatives and insect repellent sprays. Unfortunately, here in Los Angeles we have learned to our dismay that smog apparently destroys these beneficial factors in organically grown foodstuffs. Possibly, such optimum foods possess unidentified antibiotic factors that are antagonistic to malignant growths in some humans. Some recent evidence attributes such beneficial actions to certain antibiotics studied so far.

This brief clinical note is written with the hope that it may prove of possible benefit to other Coloproctologists dealing with apparently hopeless malignant disease in their own patients. Surely, this recommended adjuvant therapy is innocuous and might prove life-prolonging or even arresting the further progress of the malignant disease. This is certainly worth trying and remembering for possible future use.

7046 Hollywood Boulevard

(EXHIBIT #1) p. 2

No	Patient's Initials and Occupation:	Sex, Age—at Death, Race:	Type of Malignancy and Grade:	Metastases present?	Age at time of Diag. of Malig.:	Location of Malignancy:	Was Surgery Performed?	Type of Operation Performed:	Was Organically-Grown Food Eaten? Pre-Op.:	Post Op.:
1.	R.L.F. Painter	Male 84, W.	Adeno—Ca., iii.	Yes, in Liver.	52.	Descend Colon.	Yes.	Partial Left—Colectomy; Transverse to Sigmoid Colotomy.	No.	Yes.
2.	S.R.S. Student. House-wife.	Female 78, W.	1. Osteogenic Sarcoma. iii; 2. Adeno—Ca., ii.	1. ? 2.— Yes.	1.— 15, 2.— 54.	1. Rt. Femur, Mid. 1/3; 2. Mid-Rectum.	Yes.	1. Amputation, Rt. Thigh Prox. 1/3. 2. Comb. Abd.-Perineal Resection.	1. No. 2. No.	1. No. 2. Yes.
3.	J.R.Mc M. Butcher	Male 81, W.	1. Adeno—Ca. iii. 2. Lymph.—Leukemia 3. Adeno—Ca. iii.	1. Yes. 2. Yes. 3. Yes.	1.— 48, 2.— 50, 3.— 60.	1.— Stomach. 2. Generalized: 3.— Recto-Sigmoid.	1.— Yes. 2.— Yes. 3.— Yes.	1. 2/3rd Gastric-Resection, Ant. Polya. 2. Biopsy, base L. Neck. 3. Combin.-Abd.-Perin. Resection.	1. No. 2. No. 3. No.	1. No. 2. No. 3. Yes.
4.	R.W.C. Janitor.	Male 74 Negro.	1. Hodgkin's Dis. 2. Adeno—Ca. ii.	1. Yes. 2. Yes.	1.— 27, 2.— 53.	1.— Generalized. 2. Upper Rectum.	1.— Yes. 2.— Yes.	1. Biopsy L. Axilla. 2. Comb. Abd.-Perineal Resection.	1. No. 2. No.	1. No. 2. Yes.
5.	R.T.J. Accountant.	Male 79, W.	Adeno—Ca., iii.	Yes.	59.	Cecum.	Yes.	Rt. Hemi-Colectomy, Ileo-Transverse Colostomy.	No.	Yes.

*** *Note:*—These were all my own personal Patients.

(EXHIBIT #2)

VARIATIONS in MINERAL CONTENT in VEGETABLES. (Firman E. Bear report. Rutgers Uni.)

	Percentage of dry weight		Millequivalents per 100 grams dry weight				Trace Elements, parts per million dry matter				
	Total Ash or Mineral Matter	Phosphorus	Calcium	Magnesium	Potassium	Sodium	Boron	Manganese	Iron	Copper	Cobalt
SNAP BEANS											
Highest	10.45	0.36	40.5	60.0	99.7	8.6	73	60	227	69	0.26
Lowest	4.04	0.22	15.5	14.8	29.1	0.0	10	2	10	3	0.00
CABBAGE											
Highest	10.38	0.38	60.0	43.6	148.3	20.4	42	13	94	48	0.15
Lowest	6.12	0.18	17.5	15.6	53.7	0.8	7	2	20	0.4	0.00
LETTUCE											
Highest	24.48	0.43	71.0	49.3	176.5	12.2	37	169	516	60	0.19
Lowest	7.01	0.22	16.0	13.1	53.7	0.0	6	1	9	3	0.00
TOMATOES											
Highest	14.20	0.35	23.0	59.2	148.3	6.5	36	68	1938	53	0.63
Lowest	6.07	0.16	4.5	4.5	58.8	0.0	5	1	1	0	0.00
SPINACH											
Highest	28.56	0.52	96.0	203.9	257.0	69.5	88	117	1584	32	0.25
Lowest	12.38	0.27	47.5	46.9	84.6	0.8	12	1	19	0.5	0.20

What is a "Well Balanced Diet?"

PLEASE NOTE CHART ABOVE

See the tremendous variation in food minerals in the vegetable specimens from the varying soil qualities.

Does the consumer who selects food on the basis of price, quantity and appearance alone -- with no thought as to QUALITY -- run the risk of becoming mineral deficient?

(EXHIBIT #3) p. 1

Nationwide Food Consumption Survey 1977-78
Preliminary Report No. 3

NUTRIENT LEVELS IN FOOD USED BY HOUSEHOLDS IN THE UNITED STATES, SPRING 1977

U.S. Department of Agriculture
Science and Education Administration January 1981

(EXHIBIT #3) p. 2

ABSTRACT

This report presents findings on the levels of nutrients in food used by about 3,500 housekeeping households surveyed in the 48 conterminous States in the spring of 1977 (April-June). The nutrient content of food used at home was estimated using information collected on the kinds and quantities of food used by the households during 7 days and U.S. Department of Agriculture food composition tables. The nutrient levels of food used by each household are expressed as percentages of the 1974 Recommended Dietary Allowances set by the Food and Nutrition Board of the National Research Council, National Academy of Sciences. Findings are given for households classified by region, urbanization, and income.

KEYWORDS: Food consumption survey, household food, nutrient levels, nutrient levels by income, nutrient levels by region, nutrient levels by urbanization, Recommended Dietary Allowances.

CONTENTS

A free copy of this publication is available from the Consumer Nutrition Center, Human Nutrition, Federal Building, Hyattsville, Md. 20782.

Science and Education Administration, Nationwide Food Consumption Survey 1977-78, Preliminary Report No. 3, January 1981

Published by the Office of the Director, Science and Education Administration, U.S. Department of Agriculture, Washington, D.C. 20250

(EXHIBIT #3) p. 3

TABLE 1.--U.S. households using food that provided RDA by region, urbanization, and income, spring 1977

Item	Percent of households											
	Food energy	Protein	Calcium	Iron	Magnesium	Phosphorus	Vitamin A	Thiamin	Riboflavin	Vitamin B_6	Vitamin B_{12}	Ascorbic acid
All households[1]..........	76	97	67	84	74	95	80	87	94	65	87	93
Region:												
Northeast..............	76	97	67	84	75	95	84	87	95	66	89	95
North Central..........	78	97	69	85	76	97	79	88	95	65	90	92
South..................	75	96	62	84	71	94	75	87	92	65	82	91
West...................	76	97	72	81	78	96	83	85	94	64	90	94
Urbanization:												
Central city...........	73	95	64	83	73	93	82	84	92	66	85	92
Suburban...............	78	99	70	84	78	97	82	89	96	68	91	95
Nonmetropolitan........	77	97	66	84	73	96	76	88	94	63	85	91
1976 income, before tax:[2]												
Under $5,000...........	74	93	62	84	69	91	78	89	91	59	79	90
$5,000-$9,999..........	74	96	62	81	72	94	78	87	93	63	83	91
$10,000-$14,999........	76	98	67	83	75	97	78	86	95	67	89	92
$15,000-$19,999........	76	98	67	83	76	96	78	85	94	67	91	94
$20,000 or more........	81	99	73	87	81	98	86	90	96	73	94	96

[1] Total 3,474.
[2] Includes only households (2,776) providing income information.

Source: USDA Nationwide Food Consumption Survey 1977-78, 48 conterminous States, spring 1977 (preliminary).

(EXHIBIT #3) p. 4

Nutrient Levels in Food Used by Households, Spring 1977

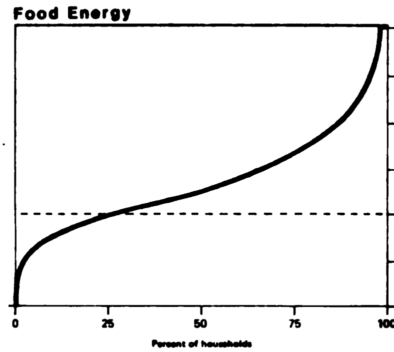

Figure 1

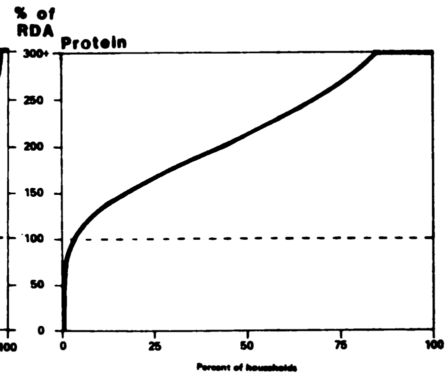

Figure 2

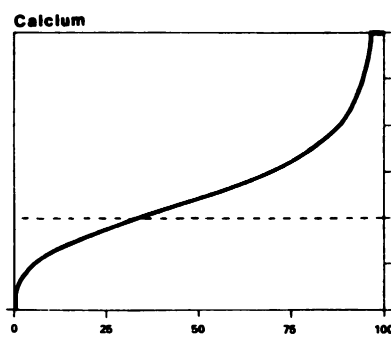

Figure 3

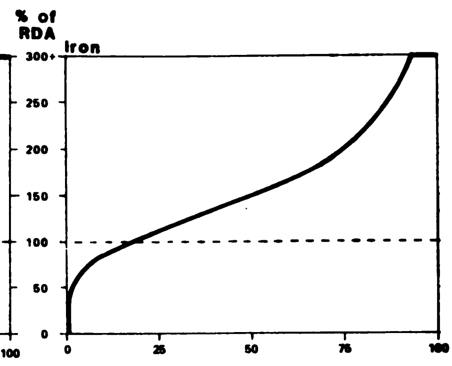

Figure 4

Source: Recommended Dietary Allowances, 1974.
USDA Nationwide Food Consumption Survey 1977-78,
48 conterminous States, spring 1977 (preliminary).

STATEMENT

of

Charles M. Benbrook, Executive Director

Board on Agriculture

National Research Council

Mr. Chairman, Members of the subcommittee, I am Charles M. Benbrook, Executive Director of the Board on Agriculture, National Research Council. The Board on Agriculture is one of eight major operating units of the NRC. We focus our efforts on the agricultural sciences and the many ways science and technology impact U.S. agriculture. We also carry out studies on renewable resource issues, and environmental and regulatory concerns. Fisheries, wildlife, and forestry resources also fall within the purview of the board. Specific projects undertaken by the board may address a full spectrum of issues from basic science and research questions, to education and manpower needs, and federal policies. I presented an address recently for Frank Press, president of the National Research Council, at the National Governor's Conference on Agricultural Innovation. Because much of Dr. Press' address is pertinent to the relation between agricultural research, productivity, and management systems, I have attached a copy for your review.

The Board on Agriculture has not studied S.1128, and has no formal position on the legislation. The board is, however, keenly interested in how alternative farming methods can help increase productivity on American farms. Based on documented achievements in terms of yields and production costs, there is clearly something profound occurring on well-managed organic farms. The board would very much like to study, and hopefully explain how alternative management systems use natural processes in place of purchased inputs. This is a valid and

intriguing scientific question.

Growing numbers of farmers and agricultural scientists in the U.S. are displaying real and sustained interest in alternative farming practices. This interest is reflected in investments by farmers in new knowledge, equipment, and production systems. The interest of scientists is apparent in attendance at professional meetings, requests for the Science and Education Administration Organic Farming report and other pertinent literature, and the number of research proposals submitted whenever a public or private institution announces the availability of funds to conduct research on alternative farming systems. This interest reflects concern over rising agricultural production costs, declining farm profit margins, threats of energy curtailment, and environmental pollution and resource degradation. Sensible, modern solutions to these ageless agricultural problems need to be found. Alternative agricultural production systems offer great promise in both solving these problems, and in pointing the way toward new hybrid production strategies combining modern and traditional organic farming techniques. I might add that biotechnology may lead to several new technologies which use highly advanced science to better exploit basic natural processes and cycles. These technologies may tremendously expand the tools of the alternative farmer.

The 1980 USDA/SEA report on organic farming indicated that even a partial shift to low-energy agricultural systems would alleviate some major problems confronting U.S. farmers. Recognized benefits of organic farming include: lower operating costs, more effective erosion control, increased environmental protection, and a more self-sufficient and sustainable production system. A degree of public confusion and ideological disagreement continues, however, regarding

whether organic farming is a labor- and manure-intensive regression into the past or an economically viable, modern production system. This wide range of perceptions suggests that an impartial assessment needs to be made of the scientific basis of organic farming as part of modern production agriculture. If enacted and carried out, S.1128 would provide data useful to such an assessment.

Organic farming and alternative management systems are receiving broader recognition as important areas for research. Public interest is also growing. The Board on Agriculture believes the time has come to examine these systems with a view to overall farm policy. We see increasing evidence that these systems have the potential to reduce farmers' costs of production. It is also possible that they can be used as a cost-effective supply control strategy in the context of our commodity programs, while also encouraging sounder resource use patterns. The Board on Agriculture discussed these issues during its May meeting and decided to approve a proposal for a project which would explore the policy implications of, and research needs for alternative farming systems. Pending approval by the NRC governing board, the Board on Agriculture will pursue funding to undertake an NAS/NRC study titled The Role of Alternative Farming Methods in Modern Production Agriculture.

The objectives for the proposed Board on Agriculture study are:

1. Summarize scientific knowledge relevant to potential future uses and benefits of alternative farming systems in U.S. agriculture, updating and building from the 1980 USDA report.
2. Examine the potential of these systems as a means to accomplish national soil conservation and production

adjustment goals.

3. Define a prioritized research agenda.

A copy of the proposal is attached for your review.

I should like to turn now to specific issues related to the bill before you. I am somewhat concerned about the process used to select six farms for the pilot research projects. It is important that such research and demonstration projects be conducted on real, functioning farms. The information from the projects would be most valuable if it came from production systems used by organic or alternative farmers able to compete with their neighbors using conventional techniques. The research design should focus, to the extent possible, on documenting the physical and chemical processes and cycles which allow certain farmers to produce profitably with relatively fewer purchased inputs.

Another, related concern is the need to investigate organic farming as an integrated system, and not to simply look at the components separately. Kohl and Lockeretz, in a statement prepared for the house subcommittee hearing on the Organic Farming Act of 1982, noted that, "The worst possible outcome of establishing regional centers would be for them to fall into the hands of researchers who do not understand what organic farming is." A lack of understanding, or bias against organic principles could lead to an experiment purporting to compare conventional with "organic" farming systems. The scientific validity of such an experiment would be questioned if the only real difference between the plots was simply, for example, herbicide-treated versus untreated. Organic agriculture is not the mere absence of conventional production practices. Organic farming is

a systematic production system that uses a combination of practices including crop rotation, legumes as a source of nitrogen, and appropriate tillage and cultural practices, etc. Such systems take time to implement, must be carefully monitored, and require good management skills--just like conventional systems.

I would like to offer a few comments on my own behalf, drawing on my three years experience as the staff director for the agricultural research subcommittee of the House Committee on Agriculture. In several congressional hearings, USDA officials have argued that organic farming research activities have continued largely unchanged, and that there is no need for this legislation. A list of ongoing USDA research projects relevant to organic farming would legitimately include nitrogen fixation, nutrient uptake, minimum tillage, soil conservation, and other areas of research. Still, USDA's ongoing research activities cannot be expected to produce much insight on the factors accounting for the cost effectiveness and increased productivity of integrated, systematic organic farming. That's the issue addressed by this bill.

This legislation is responsive, albeit perhaps not in the optimal way, to a legitimate set of concerns felt by many farmers, ranchers, consumers, and rural residents. Indeed, I think it is clear that a majority of the some 2.4 million U.S. farmers would both welcome and benefit from a sustained commitment to such a research program. The million plus small-scale market gardeners also have major, unmet information needs which this bill would help address.

I think a disservice is done to U.S. agriculture as a whole by not responding in a more balanced way to the research and education needs of this particular agricultural constituency. Research on alternative, low-cost production systems may also lead to important new insights that benefit all farmers. Thank you for the opportunity to present these views. I would be glad to respond to any questions you might have.

An Address by Frank Press
President

The National Academy of Sciences

to

The Governors' Conference on Agricultural Innovation
National Governors' Association

Little Rock, Arkansas

June 4, 1984

Good afternoon. This conference could not be more timely. The agricultural sciences are in a period of ferment. Research agendas in both the public and private sectors are rapidly changing as the tools of biotechnology are applied in new ways to old agricultural problems. Agricultural esearch opportunities have captured the imagination of research administrators bench scientists, and the public. Moreover, the international development community s intrigued with the promise of emerging technologies to overcome long-standing production constraints in many parts of the developing world.

Against that background I ll focus my talk on three elements: first, the current public policy setting vis-a-vis agricultural rsearch; second, the policy implications of the increased emphasis on productivity as opposed to production; and, finally, the recent work and intentions of my own institution in agricultural innovation.

First, the agricultural research system in indeed going through what Congressman George Brown of California termed a mid-life crisis. We ought to welcome that. Occasional ferment can be healthy for complex systems I think this will prove to be true in the agricultural sciences. As you know, in the last few years, the agricultural research system has had extensive and intensive scrutiny Dozens of reports and reviews have been issued on agricultural research. The findings and recommendations of these efforts, some done when I served as President Carter's Science Adviser, have been remarkably consistent.

Briefly put, the criticisms have coalesced on several points:

- overemphasis on highly applied research to the cost of fundamental work
- the isolation of agricultural scientists from mainstream biological research;
- poor or declining quality of research in the agricultural sciences;
- insufficient coordination among the various institutions engaged in agricultural research.

These criticisms, which first emerged in 1972, with the issuance of the Pound report by the Academy are now being reflected in the federal goverenment's budget. Thus, there is a provision for a competitive research grant program. This program has progressed from an almost radical proposal floated somewhat tentatively in the mid 1970s, to one of the more enthusiastically promoted new spending initiatives in the President's 1985 budget proposal for the U.S.

Department of Agriculture. Not surprisingly, the $28.5 million increase proposed for the next fiscal year in the competitive grants program would support biotechnology research.

Further the Department is initiating several steps to significantly enhance its in-house capacities in fundamental research. Within ARS, management activities have been streamlined. An extensive in-house examination of the long range research objectives and goals for ARS has been completed. As part of this planning activity, the ARS has requested the Board on Agriculture, of the National Research Council to examine research opportunities in the area of bioregulation. Later this summer the board will advise ARS on how it might most effectively pursue exciting new lines of research in this promising field. Congress in turn, has been supportive of these initiatives. In subcommittee action just last week, the Appropriations Committee added several million dollars to the Administration's request for the Agricultural Research Service. Overall there has been steady even growing public support for agricultural research during the past few difficult budget cycles. That support, I believe, stems from the confidence people continue to have in the agricultural research system.

We welcome these changes They are overdue. However, you need to remember that Washington like everything else runs in cycles that hope can follow disillusionment; that higher budgets for science and education raise expectations for demonstrable technological accomplishments which often are difficult to deliver as soon or as dramatically as some might like. If those cycles are to be smoothed out, it is vital that the expectations we have for agricultural research be salted by realism. Let me offer some examples Last month my institution held a symposium on technological frontiers and foreign relations. One of the speakers was Ralph Hardy director of life sciences for Dupont. He pointed out quoting "that excessive expectations among almost all sectors of society have been created by the new biotechnologies " and then went on to emphasize that for crop agriculture we should not expect major impacts in the short term. Overall, he said, the science-technology base for agriculture is substantially weaker than for health care reflecting the smaller R&D investments that have occurred in recent decades for agriculture." In fact, Hardy added, the two leading centers for plant science research related to biotechnology are located in Australia and the U.K., and not in the U.S."

Further, the infusion of biotechnology into agriculture may not be a pure blessing. Hardy pointed out that biotechnology may, in fact, reduce the competitive strength of U.S. agriculture. For example, he noted that "biotechnology may decrease the vulnerability of crops to water and temperature stress so that countries like the U.S.S.R. could produce consistently higher yields... ."

A similar comment on the possible downside to biotechnology was made by William Brown Chairman of the Board on Agriculture, of the National Research Council Brown pointed out that "as we offer the farmer increasingly sophisticated and costly technological packages, we inadvertently exacerbate two related sources of instability in agriculture. High yield production systems are often more volatile in terms of harvested production, and more erratic in terms of profit for the farmer " And Bill Brown asked "What policies should we pursue to deal with these growing sources of instability? Who should pay for costs associated with them?

The agricultural community--scientists, policy-makers, and producers--faces a great many challenges in exploiting for the good of our nation, and the world, the promise of biotechnology. In facing these challenges, it is important to recognize the influence on

science policy of broader social, economic, and technological trends. One of your conference themes is, in fact, a good example. I refer to your focus on the impacts of agricultural innovation on farm incomes. I don't have to remind you that the agricultural sector has experienced severe economic difficulties over the last three years. Let's hope this growing season marks an end to this troubling period.

Whether we can avoid similar traumas in the future rests in good part on how smart our total agricultural system becomes. We have to be more clever and entrepreneurial in conducting the business of farming, from the farm gate to the negotiating table in trade talks. Equally important, the system needs to find ways to collectively pursue sound, clearly understood goals. Lowering per unit production costs through better management and new production systems is one goal. I am speaking here of the need for a fundamental change in philosophy both for the agricultural research establishment and for the agricultural sector as a whole. Such a basic change won t happen until there is widespread agreement that such a change indeed offers the most sound basis for future competitiveness. Individuals representing all the diverse institutions that shape agricultural policies, need to carefully consider the need and justification for a new orientation toward cost-efficiency rather than yield enhancement.

Productivity gains can be achieved in many ways Historically rising per acre crop yields have proven to be the most reliable path to greater productivity During the export boom of the 1970s, efforts to progressively boost yields upward were pursued with little attention to steadily rising par unit production costs. The determination of some farmers to continuously raise yields has persisted since 1980 in the face of both natural constraints and deteriorating market conditions. In some areas, the productivity of resources already invested in agriculture has declined markedly in the past few years A great deal of capital, borrowed for long terms at high rates of interest, is tied up in new machinery and buildings, much of which are now idled or underused as a result of poor prices, government programs to restrict supply, and weak export demand. As we look ahead to the 21st century, we can expect continued volatility in basic agricultural markets. Dealing with the economic ramifications of this volatility is clearly one of the nation's most pressing agricultural policy issues.

As I mentioned, the most reliable way for farmers to reduce production costs, historically, was to increase per acre yields. Research scientists accommodated this perception by focusing on ways to increase yields. Their work has been, in a sense, too successful. It is a bothersome irony in this hungry world that the U.S cannot profitably market a significant portion of its agricultural output in most years. Agricultural overproduction imposes great costs on the treasury, denying funds for research, conservation, and other programs which build future productive capacity

Surpluses also lead many to question the social value of agricultural research expenditures Such doubts are to some degree valid if a major goal of publicly-funded research continues to be developing high-cost technologies that raise per acre yields, but also reduce American agriculture's ability to effectively compete in world markets.

Having said that, let me emphasize that, while there can be too much production, there can never be too much productivity. Production s an aggregate measure expressed in bushels of wheat, or bales of cotton. Productivity is a far more complex concept. It refers to a ratio of all outputs from an enterprise to all inputs used in the production process. Agricultural productiv ty can rise while production falls, and vice versa. Herein lies a possibly cost-

effective approach for meeting future competitive challenges. We nee to become experts at increasing productivity, while decreasing production of surplus commodities.

Research is the essential element in raising productivity. The key is focusing on the right scientific challenges. It is clearly important for researchers to pursue the most promising areas of research. Appropriate mechanisms are now in place, or are under consideration, to effectively identify these research areas. Indeed, the Academy, with its sister institutions, the National Academy of Engineering and the Institute of Medicine, in 1983 prepared a briefing for the President's science adviser on the most promising areas of agricultural research in the plant sciences. Further, the Board on Agriculture, of the National Research Council, has a continuing responsibility to track the direction and effectiveness of agricultural research, and has several studies underway to do just that. Setting the right priorities is just one half the battle. It is equally vital that scientific exchange and collaboration infuse the scientific enterprise with innovative, dynamic thinking. All components of the system, state and federal facilities, private companies and institutions, and academia need to play a role in advancing science and the development of cost-effective agricultural technologies and management systems. Because there are so many new scientific opportunities emerging, and such sizeable growth in both public and private sector commitments to agricultural research, I hope that research leaders from all sectors will be innovative, determined, and aggressive in fashioning improved channels for scientific dialogue and collaboration.

A lesson from other technology-based sectors of the economy applies well, I think, to agriculture. It is not enough to just face the future and accept its course as determined by politicians, the press, and the often unpredictable events that attract attention and shape opinion. Agricultural scientists should anticipate, even help shape the future by actively participating in public forums that will establish the policies governing how science and agriculture interact in the next century.

While the pace of technological change in U.S. agriculture has been brisk for decades, it is likely to become even more dynamic in the years ahead. It is vital for the scientific community to play an active role in articulating for others critical contemporary research needs. The scientific community must approach this task unselfishly, and from a perspective encompassing the combined activities of the public and private sectors.

Such a shared sense of future opportunities and obligations will serve the country well as we move forward to capitalize on rapidly emerging scientific opportunities. We must be diligent and prudent in considering the full range of impacts of technologies to avoid regressive public policies which hold back innovation. Scientists need to incorporate a finer sense of economic realities on the farm so that future technologies help restore America's comparative advantages as the world's major exporter of agricultural commodities. Agricultural scientists also need to help shape social expectations and policies governing the application of science and technology to agricultural production problems. Again, I remind you that in this enthusiastic era, science should not promise more than it can realistically deliver, nor should the public be expected to support projects that are poorly conceived, unfocused, and ultimately of little constructive value.

One of the most pressing challenges that deserves immediate attention involves the institutional collaboration of the public and private sectors in agricultural research. The scale of private sector research has grown tremendously in the last decade. Private sector

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research has also become more narrowly focused in areas likely to lead to profitable products. Specialty crops and scientific questions not relevant to product development tend to receive little or no attention. Addressing these concerns is of course one of the appropriate missions of public research institutions. Still, important institutional constraints and issues need to be resolved so that scientific developments flow smoothly through both the public and private sectors, reaching the farmer without undue delay as affordable, effective new technologies. One encouraging development is the formation of several new interdisciplinary teams of scientists that combine basic science expertise in fields like molecular biology with more traditional agricultural sciences like plant genetics. These teams are an enormous new asset for agricultural research. Many of them are the result of university-industry collaborations, and are conducting the basic research which will allow us one day to produce plants that have better nutritional qualities, resist stress, produce proteins and carbohydrates more efficiently, provide their own fertilizer from the air and soil, and photosynthesize more efficiently.

The Academy complex views these public-private sector challenges as of great importance, both to the nation and to scientific progress. For this reason, we have initiated a new academy program this year, called the Government-University-Industry Roundtable. This Roundtable will provide a new forum for the exchange of ideas. The goal of the Roundtable will be to identify and sharpen innovative mechanisms for constructive dialogue and collaboration.

Finally as I indicated earlier, we have within the National Research Council the Board on Agriculture That un t is broadly concerned with the agricultural sciences and other renewable resources involving fisheries, wildlife and forestry. That concern covers the full spectrum: from basic research to education and manpower to federal policies The Board is now preparing a white paper on agricultural research. That paper will address several key issues, including many explored during this conference. It will, I hope, prove invaluable in providing a common focal point for all those concerned with the future of agricultural research. The board's report will be completed this summer, and circulated broadly in the fall.

I know it's traditional to begin agricultural speeches with a joke. Since I didn't do that, I'll end this speech with one. I think it pertinent to an implied theme of this conference: the still considerable gap between basic science and agricultural realities. Some time ago, there was a major chicken epidemic in one of the states. The farmers, in desperation, called the local university. They got no help from the departments of poultry science, animal science, veterinary medicine and biology. Finally, they talked to a theoretical physicist, who said, yes, he could help.

The next day, the farmers marched into a classroom. The physicist came in, went to the blackboard, and said, "Now, first imagine the chicken as a perfect cube."

Thank you for having me. I'll be delighted to try to respond to your questions.

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May 15-17, 1984

NATIONAL ACADEMY OF SCIENCES
NATIONAL RESEARCH COUNCIL
BOARD ON AGRICULTURE

A Proposal for a Study on
The Role of Alternative Farming Methods in
Modern Production Agriculture

SUMMARY: U.S. farmers and scientists are increasingly interested in alternative farming practices because of concerns over rising agricultural production costs, declining farm profit margins, soil erosion threats of energy curtailment and environmental pollution. At the same time, U.S. agriculture is plagued with commodity surpluses, despite several billion in expend tures each year through a variety of federal programs designed to control production while promoting soil conservation.

The 1980 USDA report on organic farming indicated that even a partial shift to low-energy agricultural systems including use of techniques used in organic farming systems would alleviate some major problems confronting U.S. farmers Recognized benefits of organic farming include lower operating costs, more effective erosion control, increased environmental protection, and a more self-sufficient and sustainable production system. The USDA report generated considerable interest much of it from conventional farmers, but a degree of public confusion and ideological disagreement continues regarding whether organic farming s a labor and manure intensive regression into the past, or an economically viable, modern production system.

Several sources, including the 1980 USDA report and a 1984 publication from the American Society of Agronomy have developed organic farming research agendas. Because of a dramatic, somewhat unexpected change in the economics of U.S. agriculture since 1980, however, there is a pressing need at this time to appraise organic farming systems from a holistic national perspective in light of other farm policy objectives, most notably reducing costs of production, controlling commodity surpluses, fostering resource conservation, and improving environmental quality.

The Board on Agriculture proposes to assemble a small committee of scientists to (1) summarize scientific knowledge relevant to potential future uses and benefits of alternative farming systems in U S agriculture, updating from the 1980 USDA report; (2) examine the potential of these systems as a means to accomplish national soil conservation and production adjustment goals and (3) define a prioritized research agenda. Total estimated cost for a sixteen-month study from June 1, 1984, to September 30, 1985, is $220,000 Support is sought from USDA, EPA, and private industry and foundations.

BACKGROUND: Economic stress on U.S. farms and ranches, caused in part by rising agricultural costs per unit, is generating renewed interest in alternative farming practices. Scientists and farmers are concerned, as well with economic sustainability of soil and water resources consistent with environmental quality goals, and these concerns are forcing a re-evaluation of cropping patterns and management systems, particularly in regions characterized by highly erodible cropland combined with heavy demand from other sectors for water supplies The farm price support program (including current measures such as PIK) was started as a temporary program 50 years ago and reached a

historic high cost in 1983. The program has always intended to promote soil conservation, yet soil losses, like commodity surpluses, continue to be unacceptably high in some cases.

A growing number of conventional farmers are expressing interest in and adopting alternative farming practices. The 1980 USDA report on organic farming indicated that even a partial shift to low-energy agricultural systems including use of organic farming techniques, would alleviate many major problems confronting U S. farmers Reducing the use of energy intensive chemical fertilizers and pesticides lowers farmers operating costs Studies have shown that net profits are comperable with those of conventional farmers although yields can be lower In an era of unmanageable surpluses, however, lower yields might be used to advantage as a tool to manage the overall farm program Compared with conventional, engineering technologies several alternative farming practices result in effective soil erosion control at lower cost use of green manure and cover crops; crop rotation systems that include grass, legume and small grain crops application of animal manure and other organic materials and tillage methods that retain crop residues and organic matter. Because runoff is reduced there is less pollution of surface waters with sediments plant nutrients, and pesticides; leaching of these materials into groundwater is also reduced Emphasis on self-sufficient systems could mean greater long-term sustainability and security of U.S. food and fiber production. Due to use of fewer biocides and chemical fertilizers alternative farming systems result in sufficient net savings of energy, even though more fuel is required for spreading organic wastes and for weed cultivation.

The 1980 USDA report received considerable interest, much of it from conventional farmers. Over 35,000 copies were distributed by USDA in response to requests. Organic farming is gaining scientific recognition as well: for example, the American Society of Agronomy recently published Organic Farming: Current technology and its role in a sustainable agriculture (ASA Special Publication No. 46, 1984). There is still a wide range of perceptions of organic farming, however, indicating that an impartial assessment needs to be made of its scientific basis as part of modern production agriculture. Furthermore, opinions differ widely on the degree to which USDA is implementing the specific recommendations of its 1980 report. Several sources, including the 1980 USDA report and the 1984 ASA publication, have developed research agendas, but these recommendations need to be consolidated and prioritized in terms of national needs.

OBJECTIVES: The objectives for the proposed study are:

1. Summerize scientific knowledge relevant to potential future uses and benefits of alternative farming systems in U.S. agriculture, updating from the 1980 USDA report.

2. Examine the potential of these systems as a means to accomplish national soil conservation and production adjustment goals.

3. Define a prioritized research agenda.

PLAN OF ACTION: A committee of eight to twelve scientists with expertise in soil science, economics, soil microbiology, ecology, plant physiology, food chemistry or human nutrition, agronomy, pest control, and organic farming will meet initially to define the scope of the project and to agree on schedules and assignments for drafting parts of the report The first meeting will be held at a location from which site visits can be made to farms using organic farming

systems. Discussions will be structured to examine the role of organic farming in the U.S. agricultural system, to formulate policy options based on the committee's findings, and to analyze implications of these options. Project staff will work with the committee in preparing a report. At least two additional meetings will be held to review the report draft and refine the project's recommendations.

ANTICIPATED RESULTS: The committee's report will draw upon current scientific knowledge to help clarify some misperceptions that prevail about both alternative farming and conventional agriculture. It will present a timely consideration of the relation between modern organic farming systems and the need for more cost-effective price support/ production control policies that are more effective in light of soil, water, and energy conservation goals. By presenting a prioritized research agenda, the report will help focus national attention on research and information needed to resolve critical scientific questions. The committee's report will be a valuable guide to the Department of Agriculture and other groups engaged in the process of reshaping agricultural policies as part of, and in response to the 1985 farmbill. The report will be of interest and use to scientists and students in agronomy, soil science, ecology, plant protection, weed scientists, agricultural and resource economics, and human nutrition, as well as to federal and state agencies (e.g., USDA, EPA, AID, NSF, FDA, fish and wildlife agencies), agribusiness, and farmers. There is also considerable international interest in this topic.

The report resulting from this project shall be prepared in sufficient quantity to ensure distribution to sponsors, committee members, and other parties interested in the topic. To facilitate wider distribution, the Executive Summary will also be printed separately. A proceedings volume may also be published if the committee chooses to hold a convocation as part of the project.

U.S. SENATE,
Washington, DC, June 19, 1984.

Hon. RICHARD G. LUGAR,
Chairman, Subcommittee on Agricultural Research and General Legislation, Washington, DC

DEAR DICK: Mr. David Granatstein of Washington State University would like to submit his enclosed remarks as testimony on the Agricultural Productivity Act. I would greatly appreciate your including his testimony in your hearing record for this legislation.

Thank you for your assistance.

Sincerely,

SLADE GORTON.

Enclosure.

STATEMENT OF DAVID GRANATSTEIN, WASHINGTON STATE UNIVERSITY

Secretary of Agriculture John Block asks "if it is necessary to study whole farm systems . . ." (p. 18).[1] Most of us know from experience that when we go to the doctor for an ailment, the first step is a general check-up to see how the system as a whole is functioning. From the symptoms observed, the doctor can then consider the causes and hopefully treat the latter and not the former. Unfortunately, Secretary Block's attitude reflects the symptomatic approach used in this country for addressing our agricultural problems. Today, agriculture is viewed much like any other industrial process, with a given set of inputs, a clear set of reactions, and a consistent and reliable output. But there is a limit to which one can try and fit a biological process into an industrial mold. What tends to happen, as Wendell Berry aptly describes in "The Gift of Good Land," [2] is that for each problem solved, several more are created. We continue to hack away at the Medusa, while our resouce base and rural life become more degraded. Instead, looking for "agricultural solutions to agricultural problems" offers a different approach. Berry cites the example of the backyard garden as the type of solution that "creates more solutions, not more problems". In the process of providing good fresh food, the garden uses waste materials, provides exercise, and saves money. To me, this is the intent and content of the Agricultural Productivity Act (H.R. 2714).

The bill is indirectly asking us to take a look at the direction of our agriculture and some of the systemic causes of the current problems are facing. Farmers are looking very hard for alternatives to their present situation and the path that lies ahead. But they are not offered many choices outside the methods now accepted. In taking a "systems" approach, H.R. 2714 hopes to develop and substantiate some real alternatives and let farmers make the choices themselves. Most farmers will not make changes that involve much risk, due to both their nature and their pocketbook. The dramatic changes we have witnessed in agriculture were relatively low risk, being based on extensive research and obvious results. And now some of the problems are all too obvious. Alternative methods of production must be given the same thoroughness of investigation if we hope to provide real choices.

Many of the criticisms of the bill focus on duplication and separatism. In my experience with the agricultural research network in this country, anything "alternative" has been quite discriminated against for as long as I can remember. According to the critics, it is now going to be discriminatory to selectively study alternatives. And to worry that the Extension network would be burdened by having to disseminate information about alternative practices is ludicrous. There appears to be no strain in providing suggestions on new pesticides or fertilizers. Again, I consider this to be a discriminatory attitude of the USDA towards seeking alternatives to current practices.

In reading the criticisms, there is never any disagreement with the goals set out. All the objections raised are about duplication, excess workload and cost, and separation in the research effort. To me, these are weak arguments, especially when one compares $10 million for this proposal versus the $21 billion spent on the PIK program last year, for which our nation benefitted minimally in terms of any sustaining changes in the long run.

Rep. Jim Weaver states that the USDA "should begin looking at innovative, integrated farming systems that will provide our farmers with alternatives to the high

[1] Page numbers refer to H.R. Report 98-587: Improving the Productivity of American Farms; December, 1983.

[2] Berry, Wendell. 1981. "The Gift of Good Land." North Point Press, S.F.

cost, energy intensive, soil depleting practices that have been promoted for the past 30 years" (p. 22). Recommendations from USDA itself have identified the need and rationale for investigating alternative farming approaches which will lead to the long term sustainability of agriculture. This type of research will benefit all farmers, just as much of the current research does, by giving them a wider range of choices and the necessary information with which to assess risk and implement practices. Yet not all sectors of agriculture will benefit, because a goal is to reduce production inputs, such as fertilizers and pesticides, the sale of which supports a large industry. Thus, groups who stand to lose economically cannot be expected to support this type of research effort. If alternatives are to be developed, public resources will be necessary.

One of the strong points of the proposed legislation is its broadbased appoach. It intends to be of advantage to all farmers, and avoids targeting particular groups. The overriding emphasis is on providing "Alternatives for Agriculture," in contrast to promoting alternative agriculture. The former approach is one of unification, whereas the latter tends to pit interest groups against one another and obscure the common goals. This is an important shift that needs to be made in addressing our agricultural problems.

Statement of Paul R. Sacia, Assistant Director of Legislative Services, National Farmers Union

Mr. Chairman and members of the subcommittee, the National Farmers Union wishes to express its support for S. 1128, the Agricultural Productivity Act of 1983. Conditions in rural America are such that increased emphasis must be placed on creativity as we seek solutions to our agricultural problems.

S. 1128 allows the agricultural community to explore new methods of operation at a time when:

Net farm income has fallen precipitously since 1979;

Costs of production continue to rise;

Outstanding farm debt now at $215 billion stands greater than this year's national deficit of nearly $200 billion;

Water supplies for crops have dwindled as non-agricultural use of water has been on the rise;

Top soil erosion has reached an intolerable level. Currently, this average erosion level on U.S. cropland is almost 7 tons per acre per year; two tons more is considered acceptable by the USDA in maintaining productivity on a long term basis.

The Farmers Union is proud of U.S. farmers' contributions in feeding this nation and much of the world's people, largely as a result of scientific and technological advances. This Act would simply provide needed research to determine whether there are alternative production techniques useful in reducing costs of production for the farmer through less energy intensive means. Twelve on-farm pilot research projects operating over a 5-year period, while a modest experiment should give us an ample indication of the utility of a larger-scaled venture in this area.

We believe that the cost-sharing assistance to be provided by the agricultural conservation program in promoting intercropping is a key provision of this legislation. Encouraging farmers to plant legumes and grasses between rows of corn, wheat or soybeans will do much to alleviate nitrogen fixation and soil erosion problems.

As Representative Weaver of Oregon points out in support of his companion bill in the House of Representatives, H.R. 2714, both the "Department of Agriculture Report and Recommendations on Organic Farming," of July 1980 and the USDA Agricultural Research Service 6-year plan released in January of 1983, advocate exploring alternative operating methods to reduce farm production costs while encouraging conservation practices. We believe the $10.5 million price tag of S. 1128 is a small sum to pay to follow such worthy and timely advice.

We greatly appreciate your consideration on this matter.

Statement of Norman A. Berg, Washington Representative, the Soil Conservation Society of America

Mr. Chairman, the Soil Conservation Society of America (SCSA) appreciates your invitation to give our views on S. 1128 and H.R. 2714.

SCSA, a nonprofit scientific and educational organization founded in 1945, is dedicated to promoting the conservation of land and water resources.

Members worldwide, now totaling 13,000, include researchers, administrators, educators, planners, technicians, legislators, farmers and ranchers, local conserva-

tion officials, students, and others. They represent most every academic discipline concerned with the management of land and water resources.

SCSA testified in favor of H.R. 2714. We were pleased when it passed the House in January, 1984. We recognized that the U.S. Department of Agriculture basically has the authority to carry out the Information Study of Section 4. The Pilot Research Projects authorized in Section 5 would be highly desirable and the Departments' authority to establish these projects would be enhanced by this legislation. Sections 6, 7, 8, 9 and 11 would also clarify and establish direction for U.S.D.A.

Sections 10, 12 and 13 are obvious legislative requirements for U.S.D.A.'s implementation of the Agricultural Productivity Act—if it is to meet the findings and purposes of the proposal.

In many parts of the country soil losses are staggering. The Delta states, the Southeast and the corn belt are losing soil to water erosion on roughly 40 percent of their croplands, at rates faster than it can be formed. Preliminary results of the most comprehensive land and water resource inventory ever undertaken were released by the U.S. Department of Agriculture in mid-April. The 1982 National Resources Inventory (NRI) contains data collected by Soil Conservation Service (USDA/SCS) field personnel on soil erosion, land use patterns, wildlife habitat, and other resource conditions, at 1 million sample points nationwide.

According to U.S.D.A., soil erosion conditions have improved little since 1977 (the first year for which scientifically determined, nationally consistent erosion data are available). Erosion on cultivated cropland in 1982 averaged 8.1 tons per acre annually (3.3 tons due to wind and 4.8 tons due to sheet and rill erosion). On 93 million acres of cropland, 23 percent of the total, soil erosion exceeded the so-called "soil loss tolerance" (T value) by a factor of two or more, and averaged 21 tons per acre annually. (SCS defines the T value as "the maximum rate of annual soil loss that will permit crop preductivity to be obtained economically and indefinitely." The national average T value is 5 tons per acre per year.) Over 2 billion tons of soil—two-thirds of the cropland total—are eroded from these 93 million acres each year. Some form of erosion control treatment is needed on half of the Nation's 361 million acres of non-irrigated cropland. Farming can be carried on in such a way that the soil can be regenerated instead of depleted. By rotating certain crops and taking other measures, farmers can minimize weed problems and allow the soil to regenerate naturally.

Robert Rodale, president of Rodale Press of Emmaus, Pennsylvania, states that agriculture needs to be "reinvented" so it "creates rather than destroys the soil." This can allow farmers to cut back significantly on the use of fertilizers and pesticides, he says, and then farmers can maintain or improve productivity at lower costs.

SCSA is pleased that the Rodale Research Center at Kutztown, Pennsylvania, and U.S.D.A.'s Agricultural Research Service (ARS) have reached agreement on a cooperative research effort for the next three years. Dr. Jerry Radke, an ARS cropping specialist will work on simulation models that can assist in the development of resource conserving farming systems and conservation tillage. The investigations will include a range of cropping systems that rely in varying degrees on organic and inorganic fertilizers, crop rotations, and aspects of biological pest control. The research will provide an opportunity to validate models with data from regenerative farming systems located at the Research Center and other U.S. locations.

Dr. Richard Harwood, Director of Research at the Kutztown facility, said this research "is very much a cooperative effort between U.S.D.A. and the Rodale Research Center." The results of the research, according to Harwood, "will make it possible to predict what effects there would be for individual farmers and the entire agricultural sector when farmers change management practices and begin to go in the direction of low-imput, integrated farming systems." Harwood said he was "delighted that we now will have competent scientific scrutiny of regenerative farming systems from outside the alternative agriculture movement itself."

We applaud this effort and feel that S. 1128 would further the type of farming that has the potential to greatly reduce soil erosion and nutrient losses from this Nation's cropland, which in turn could significantly decrease the pollution of surface waters by sediment and agricultural chemicals, and improve the quality of fish and wildlife habitat. We recommend its approval.

SCSA thanks the Chairman for allowing the Society's testimony to be made part of the record of this hearing. We'll be available to help your Committee in any way we can.

BRATTLEBORO, VT, *June 5, 1984.*

Hon. PATRICK J. LEAHY,
Russell Senate Office Building,
Washington, DC.

DEAR SENATOR PATRICK: Your sponsorship of S–1128, Agricultural Productivity Act of 1983 is of interest to me.

As you know I have been a strong, outspoken and hard working supporter for agricultural research. Through the years my activities and support of research have been many and varied. These continue.

I wish that I could feel strongly in favor of S–1128. Unfortunately, such is not the case.

I truly believe that there are many other agricultural problems and agricultural issues which deserve a higher priority than matters related to "organic farming."

The "organic farming" issue has to be considered as being far more "emotional" than either scientific or of practical concern. Obviously, no one wishes to support a practice which would be detrimental to human health. I don't believe this is happening as a result of our current agricultural practices.

In support of the issue of emotionalism and failure to know or understand the facts, I am enclosing a photocopy from a recent publication of CAST. Herein you will find a reprint of the emotional issue as set forth by Columnist Jack Anderson and a brief response by Dr. Charles A. Black, Executive Vice President of CAST. While Dr. Black does not elaborate on the points clearly stated, they are backed by sound scientific information.

As you know, CAST is an organization of 25 professional agricultural societies, the expertise of which is brought together to address issues such as those set forth in your recent newsletter dealing with "legislation to wean American Agriculture from its chemical addiction." CAST has no axe to grind for any group or organization. Its services and expertise through the use of the technique of task forces from appropriate scientific/technical professional socieities is frequently used by Congress and similar public bodies.

Trusting that you will find this information useful, I am

Yours very truly,

ROBERT H. RUMLER.

Enclosure.

CAST RESPONDS TO JACK ANDERSON

Last Thanksgiving Day, nationally-syndicated columnist Jack Anderson put a damper on America's annual gastronomic indulgence with an article titled, "Harmful Chemicals Turn Up at the Thanksgiving Table." Readers of more than 400 newspapers across the country that subscribe to the Anderson column were told of "strange substances that have found their way into the food we eat—dangerous chemicals never dreamed of by the Pilgrim fathers." In effect, Anderson implied that the thought of a typical Thanksgiving Day meal should leave you quaking in your boots rather than licking your lips.

In order to give a more balanced perspective on the chemicals-in-foods story, CAST Executive Vice President Charles Black distributed a letter on December 8, 1983, to Anderson column subscribers. This letter and an authorized reprint of the Thanksgiving column follow.

For additional information on food safety and food additives, CAST has several publications available, including: "Science of Food and Agriculture" magazine (November 1983), "Food Questions and Answers" (Special Publication #7), and "Foods from Animals: Quantity, Quality and Safety" (Report #82).

HARMFUL CHEMICALS TURN UP AT THE THANKSGIVING TABLE

(By Jack Anderson)

WASHINGTON.—Like most Americans, I'll be sitting down with my family today for the annual Thanksgiving feast. But being a professional curmudgeon, while I count our blessings I'll also be counting the strange substances that have found their way into the food we eat—dangerous chemicals never dreamed of by the Pilgrim fathers.

The unnerving fact is that Americans have paid a price for the bounty that surrounds us. Our food is no longer produced on small family farms, but by huge agri-

business operations. They depend for their success on the constant use of pesticides that leave tiny residues in just about everything we eat.

The Food and Drug Administration conducts ongoing studies of food to identify the kinds and amounts of potentially harmful chemicals that find their way onto your dinner table. For these "market basket surveys," the FDA scientists shop at the supermarket just like any homemaker, cook the various items the way you would and then—unlike you—test the results for toxic chemicals.

My associate Vicki Warren obtained an unpublished computer printout for a recent market basket survey and checked the data for a typical Thanksgiving Day meal. Only a few of the quantities of chemicals were of questionable legality. So enjoy.

The turkey roasted by the FDA scientists-chefs was found to contain a low level of pentachlorophenol, or PCP, a wood preservative which contains the carcinogen dioxin. What's a wood preservative doing in turkey meat? For one thing, the leftover matter from cattle whose hides had been treated with PCP was ground up and put in animal feed. Though the practice was stopped last summer, PCP is still showing up in meat, apparently because of its extensive use on farm structures.

The turkey meat also contained a low level of DDE, the poisonous substance that results when DDT-contaminated plants are ingested. Though DDT has long been banned in this country, it remains in the soil and in plants that grow in that soil—and thus in the food chain. DDE shows up in almost every animal product, including milk and eggs.

If you use pork sausage in your stuffing, that also has a legal but relatively high level of DDE. The white bread you toast for the stuffing contains tiny amounts of the acutely toxic pesticide malathion as well as the phosphate diazinon.

Risk the kids' displeasure and serve spinach if you will, but know that it contains both DDT and DDE and the insecticide dieldrin. Try to sneak broccoli in as a substitute, and you'll be feeding the little nippers minute amounts of endrin, another insecticide. The use of both dieldrin and endrin has been restricted in the United States.

Mashed potatoes contain diazinon.

Squash contains Aroclor 1254, a PCB, the same kind of deadly compound that leaks out of electrical transformers.

If you use canned brown gravy, you'll invite grandma's scorn. And you'll also be feeding the family tiny amounts of malathion.

A glass of wine to aid digestion? It contains two more restricted insecticides, dimethoate and its first cousin, omethoate.

Pumpkin pie has dieldrin and heptachlor epoxide. The latter is considered dangerous.

Ice cream contains some of the same wood preservative found in the turkey (from the milk or cream), and traces of dieldrin, heptachlor epoxide and a banned but still lingering insecticide, BHC, a suspected carcinogen.

Footnote: A staff aide for a House Agriculture subcommittee, which has been trying for two years to tighten pesticide regulations, put the problem this way: "Scientifically, we can't prove that even low levels of exposure to pesticides are safe. There is clear evidence that exposure can contribute to cancer and birth defects." In other words, no one knows for sure how safe our food is.

CAST's Reply

December 8, 1983.

Dear Editor: In a greeting to Americans on the occasion of their Thanksgiving feast, columnist Jack Anderson said that, "being a professional curmudgeon, while I count our blessings I'll also be counting the strange substances that have found their way into the food we eat—dangerous chemicals never dreamed of by the Pilgrim Fathers." He then listed a number of man-made chemicals (almost all pesticides) that the Food and Drug Administration has found in foods in its "market basket surveys." He named certain traditional Thanksgiving foods in which the chemical residues had been detected.

Mr. Anderson unfortunately did not inform his readers that he was telling them only a small part of the story and that his choice of adjectives (poisonous, acutely toxic, dangerous, and deadly) would create the impression that our health may be endangered by the chemicals he mentioned even though the facts are to the contrary.

Mr. Anderson neglected to mention that pesticides make a positive contribution to human health in providing Americans with high quality food products at reasonable prices.

Mr. Anderson neglected to mention that if one adds up the toxicities of the pesticide residues in the foods one consumes in a year the total acute toxicity is equivalent to less than that of the aspirin in one aspirin tablet.

Mr. Anderson neglected to mention that, as noted by Bruce Ames in the September 23, 1983 issue of "Science" magazine, "The human dietary intake of 'nature's pesticides' [chemical substances with pesticidal properties that are produced naturally in plants] is likely to be several grams per day—probably at least 10,000 times higher than the dietary intake of man-made pesticides."

Mr. Anderson neglected to mention that foods are chemicals and that some of these chemicals are dangerous in small quantities and others only in large quantities. (Chemists have been identifying chemicals in foods for more than a century, and new ones still are being discovered. No one knows how many there are. According to an estimate made for the Senate Committee on Agriculture, Nutrition, and Forestry, there may be 100,000 naturally occurring chemicals in foods. In 1973, the National Academy of Sciences published a 624-page book entitled "Toxicants Occurring Naturally in Foods." The "Science" article by Bruce Ames briefly reviewed the scientific evidence on naturally occurring carcinogens and mutagens in foods.)

Mr. Anderson neglected to explain how the human race manages to survive when it has to depend for life upon food chemicals, all of which have unfavorable effects if ingested in excess. Nor did he explain why people live longer now than they did before modern pesticides were developed.

Sincerely,

CHARLES A. BLACK,
Executive Vice President.

STATEMENT OF TIMOTHY YEANEY AND LORETTE PICCIANO-HANSEN

Bread for the World is a national citizen's lobby focusing on public policy issues related to hunger. Bread for the World has 45,000 members organized in congressional districts throughout the United States. Our members include farmers, rural people and others interested in food and agriculture issues as they relate to problems of domestic and world hunger.

Bread for the World supports the Agricultural Productivity Act of 1983, S. 1128. We recognize this act as a very modest, though meaningful, first step in achieving an agricultural system that is both economicaly and ecologically sustainable and that will ensure food security for future generations.

One of the fundamental goals of Bread for the World is to work to achieve long term food security for the world's population. Food Security means assuring at all times that all people have access to the food they need for a healthy life. Therefore, assuring food security requires an adequate supply of wholesome food at affordable prices. An adequate supply of food cannot be assured for the future unless agricultural production is sustainable.

The current problems within U.S. agriculture have been duly noted by others who have presented testimony before this committee. The rising cost of farm inputs, mounting financial pressure on the individual family farmer, increasing erosion of soil, and rising level of contaminants in the nation's waterways all suggest that our present agricultural system is not sustainable. Change is essential. Change is coming. The question is how much direction will be given to this change by public policy.

The Agricultural Productivity Act (APA) represents an important step, albeit a small one, in shaping this direction and giving United States farmers increased opportunity to choose a type of farming operation consistent with their values and needs.

The Agricultural Productivity Act will direct research to produce tested technical information about farming systems which minimize the use of costly non-renewable resources and other farm inputs. It emphasizes an integrated approach by conducting on-farm pilot projects applying the latest technical and scientific understanding of the farm system as a whole. The majority of past agricultural research has emphasized crop-specific analysis that ignores the interrelationships that exist in a complete farming system.

Research that is directed toward real farmers on real farms will produce the data necessary for other farmers to make the transition from current farming practices to resource efficient agricultural systems. The emphasis is on diversification, not on one single approach or solution to all of the problems facing farmers. However, enactment of the Agricultural Productivity Act holds out the promise of restoring the profitability of small scale family farming, of conserving non-renewable resources

and of using all other agriculture resources more efficiently. This promise represents positive movement toward an agricultural system that is more sustainable and equitable than the current system.

Bread for the World supports this initiative. This small initial investment in research could yield great benefit in shaping the future direction of U.S. agriculture. We urge the subcommittee to support this initial step.

NATIONAL NUTRITIONAL FOODS ASSOCIATION,
Arlington, VA, June 5, 1984.

Re Senate Agriculture Committee hearings on S. 1128, the Agricultural Productivity Act of 1983.

Hon. JESSE HELMS,
Chairman, Senate Agriculture Committee,
Washington, DC

DEAR MR. CHAIRMAN: The National Nutritional Foods Association is pleased to provide testimony in support of S. 1128, The Agricultural Productivity Act of 1983. We believe that the bill is an excellent beginning in what we hope will become a national effort to improve American agriculture through the incorporation of sound, productive organic farming methods.

The National Nutritional Foods Association is the principal voice of the health food industry, composed of approximately 3,800 industry manufacturers, distributors, wholesaler-jobbers, and retailers located throughout the United States. Ours is an industry consisting primarily of small businesses. By last count, there are some 8,500 retail health food units in this country, including both independent retailers and health food sections of mass merchandisers such as Safeway and Sears. Health food stores are located in a variety of urban, suburban and rural environments and come in all shapes and sizes, ranging from small health food concerns with less than 1,000 square feet of retail space up to large natural food centers which rival small supermarkets in comparison. Sales by all health food retailers averaged $265,000 in 1983 with total industry sales of $2 billion. Compare this figure to major supermarket chains such as Safeway and Kroger, with annual sales in excess of $9 to $10 billion respectively. That is an average of over $5 million per store. By these standards, we are still one of the small, but growing, guys on the block!

DISTRIBUTION OF ORGANICALLY GROW PRODUCTS

Mr. Chairman, we believe that few, if any, studies currently exist which adequately analyze in any detail the way in which organically grown products are distributed in this country. Rodale Press has, in the past, done some excellent work in this area, but their results are not definitive. However, let us offer to you a few of our observations on this subject.

First, the distribution of organically grown products (both produce and nonproduce items) in the United States is generally recognized to be more informal and on a much smaller scale than the distribution of commercially grown food products. The market for these products is currently smaller and the consumers who purchase them are much more diverse than consumers on the whole.

Many organic farmers who grow organic produce sell directly to consumers through a variety of methods, including farm stands, farmers' markets, pick-your-own concerns, neighborhood deliveries and local co-operatives. Others distribute their products more indirectly through local or regional distributors. Many of our retailers obtain produce this way, while others buy direct from farmers.

Second, because many organically grown products continue to be considered specialized food items and not yet in the mainstream of American agriculture, these items typically bring higher retail prices than their commerically grown counterparts. However, consumers obviously believe that this additional cost is well spent because of the investment put into the product by the organic farmer to insure their nutritional integrity and because of the benefits obtained from eating them.

Third, while only a sporadic national distribution system for organic products exists at this time, to the extent that one does exist, members of the NNFA are currently very much involved in it. A large number of our retailers carry organically grown fresh produce and still more stock organically grown grain products, which do not involve expensive refrigerated shipping and storage. Overall, 2% of our industry sales, approaching $40 million, involved organically grown fresh produce. This figure varies store by store; some sell no produce at all, while others account for upwards of ⅕ of their gross sales in fresh produce. Likewise, the percentage of industry sales for grains and cereals and for bakery goods, much produced organi-

cally, in 1983 was 4.5% and 2.3% respectively. Thus, one can readily see that NNFA members are major purveyors of organically grown products.

Amongst our members are included some of the major producers of organically grown food. An example is Arrowhead Mills located in Hereford, Texas. They currently farm in excess of 1,400 acres in the northern Texas panhandle, growing a variety of organically grown grain products including whole wheat, millet, buckwheat, barley corn, triticale and brown rice. As expected, all such products tested by the Texas Department of Agriculture were found to be free of EDB. All are grown without the use of chemical fertilizers, herbicides or pesticides. They have been doing this successfully for over 25 years and their products are distributed in health food stores throughout the United States, via well-established health food distribution channels.

WHY ORGANIC PRODUCE IS BETTER

Mr. Chairman, we believe that society benefits from a strong organic farming community for a variety of reasons, both environmentally and economically.

First, eating organically grown produce is healthier. Rachel Carson was but one of the first in a long series of informed and concerned Americans to point out the danger to consumers of ingesting too many chemicals, be it fertilizers, pesticides or herbicides. Her 1958 book, "Silent Spring," was clearly a watershed. Her prophecy later became truth as we witnessed products such as the pesticide DDT and the herbicide, 2,4,5T removed from active use in 1972, followed by later suspension of chlordane, heptachlor, aldrin, dieldrin, mirex, toxaphene, and DBCP.

Eating organic products relieves consumer of concerns regarding the introduction of unwanted chemical additives into the body. In addition, we have seen mounting evidence that growing agricultural products organically results in food whch is more nutritionally complete than commerically grown products. Many producers have reported that organic products contain higher amounts of trace minerals, such as iron, calcium and zinc. These, and other micro-nutrients are essential to good health. The key to the success of organic farmers lies in the fact that one of their principal aims is to constantly build and condition the soil, rather than apply expensive chemicals which, while providing adequate amounts of nitrogen, potassium and phosphorus, actually deplete the soil of other valuable nutrients, which brings us to our next point.

Over the past forty years, Americans have witnessed a remarkable decline in the productivity of American soils. Increased erosion and decreased fertility have become the rule, rather than the exception. Literally millions of tons of superior top soil has been washed away.

Organic farming is an attempt to reverse these trends. By the use of good common sense management practices, organic farmers actually rebuild the quality of the soil they farm; literally an investment in the land.

Techniques involving crop rotation, crop residue, animal and "green" manures, legumes and the addition of a variety of organic wastes and products have the same end result; they add to and maintain the productivity and tilth of the soil They nurture, rather than destroy, a multitude of beneficial micro-organisms which typically reside in well maintained soil. The humus of the soil is likewise increased, and with it the potential to produce crops which are nutritionally superior.

Organic farmers have incorporated a number of modified tillage techniques, such as shallow plowing, contour farming and terracing, which have proven to be quite effective in controlling soil erosion. In addition, organic farming practices are environmentally sound. Because they incorporate a variety of non-chemical methods to fertilize the soil and to control weeds and pests, there is a tremendous reduction in the amount of harmful chemicals released into the ecosystem. Herbicides are replaced by mechnical weeding and preventive steps like crop rotation. Insects are successfully controlled by introducing natural predators rather than chemical pesticides. The end result is less harm to consumers, farm residents and workers, wildlife, beneficial insects and to the beneficial micro-organisms in the soil itself. A byproduct of soil erosion control is less harmful siltation of lakes and reservoirs.

The bottom line is that organic farming methods work at less cost. While productivity may decrease in some instances, the reality is that it costs less to maintain productive soils than to constantly pay the OPEC countries their due for petroleum-based chemcials to constantly reinforce an otherwise sterile soil medium. To the extent that organic farming is more labor intensive, we would rather see farming resources spent to provide American jobs than fill OPEC's coffers unnecessarily.

THE PROBLEM OF MONOCULTURE

Before completing our statement, we would like to touch just briefly upon an issue which may, in the long-run affect the viability of organic farming as much as anything else.

We speak of an alarming and growing trend in world agriculture where farmers are encouraged to plant increasing amounts of their land with a decreasing number of plant varieties. This trend, referred to as a mono-culture, involves a process where farmers are encouraged (or coerced) to stop planting their fields with old genetically diverse crop varieties and to replace them with hybrid high yield varieties developed by the folks who brought you the "Green Revolution." Recently, the National Academy of Sciences reviewed this trend toward genetic uniformity in the United States, with these results: 71% of our corn crop is comprised of 6 varieties; 50% of our wheat crop in 9 varieties; 96% of our pea crop in 2 varieties; 69% of our sweet potato crop in one variety and so on.

Some will ask the question—so where is the harm? Unfortunately, the harm is very real.

Problems of disastrous proportions have historically resulted from a lack of genetic diversity in plant varieties. The Irish potato famine in the 1840's resulted because the genetically uniform potatoes imported from South America were not resistant to a particularly harmful blight. Millions died; millions emigrated. Similar blights have in the past attacked the Ceylon coffee crop (the English now drink tea), the sugar cane crop, the banana crop, and others. All stood helpless because of an inability to locate a diversely resistant strain which could quickly be called upon to replace the variety that had been damaged. In 1916, 3 million bushels of wheat were destroyed by a wheat rust, resulting in two American "wheatless days" per week in 1917. As late as 1970, a corn blight destroyed ½ of the corn acreage in the southeastern United States. The National Academy of Sciences, in reaction to the 1970 crisis commented: "The key lesson of 1970 is that genetic uniformity is the basis of vulnerability of epidemics . . . most crops are impressively uniform and impressively vulnerable."

Introduction of these high yield hybrids is often a very costly proposition. Farmers are forced to annually restock their seed supply from the seed company since the seeds, being hybrid, cannot reproduce themselves, but must be recreated from the parent plants back at the factory. The end result is that the farmer is forced to make a sizeable seed investment each year. Additionally, these hybrids were developed to respond well only to conventional farming methods involving heavy doses of expensive chemicals. The high yield does not come cheaply.

Another significant danger, as alluded to above, is that these varieties respond to chemical, not organic, farming techniques. As they continue to overtake the marketplace, the real possibility exists that organic farmers will find it increasingly difficult to locate sufficient amounts of plant varieties which respond well to organic farming methods.

As example of how pervasive the need for chemicals has become in American agriculture, let me bring to your attention the now infamous MH-1 American tomato variety. Not only does this strain require the application of chemicals in order to make it grow and prosper, this variety can only ripen upon the addition of a spray that will get it ready at the appropriate time for market.

The principal culprit involved here is a well-known term in modern agriculture known by its acronym—"YUP"—which stands for yield, uniformity and processing. Thus, while consumers would more than likely define its most important interests in genetic development as better nutrition and better taste, the agricultural research industry works toward a more productive YUP in their breeding efforts. Varieties which provide increasingly higher yields, more uniformity and easier processing.

A disturbing example of this bias toward YUP can be seen in recent developments with the lowly, but very nutritious potato. Higher yield hybrid potato strains are constantly being introduced into third-world areas, especially South America, to replace the traditional cultivars grown in traditional centers of genetic diversity. Although higher in yield, they are much poorer in nutritional content, with an average protein content of 1.89% as opposed to an average of 3.24% for traditional varieties. Vitamin C amounts are much lower too.

Mr. Chairman, we wish to reiterate the fact that this trend does not portend well for the continued viability of organic agriculture. These new hybrid strains, developed during the "Green Revolution" of the 1960s and 1970s simply will not perform well under cultivation by organic methods in the 1980s and beyond. They are too closely wedded to chemicals.

Mr. Chairman, as if things were not bad enough already, two additional factors are currently enhancing the problem.

First, we are seeing a continuing process whereby the major world seed companies are slowly being concentrated in the hands of the companies which produce and promote agricultural chemicals. Familiar seed companies such as Burpee, Ferry Morse, Northrup-King and OM Scott have been placed under the wing of chemical giants like ITT, Monsanto, Purex, Sandoz, Union Carbide, Ciba-Geigy and Upjohn. Naturally, there is a corporate bias to conduct research and promote seeds which enhance sales of their chemical products.

Second, we are seeing a world-wide trend toward tougher and tougher plant patent laws. While we recognize that a firm investing a substantial sum in seed development should be able to protect its investment, we see such laws as allowing the seed-chemical conglomerates to overstep their bounds. In some European countries, laws have been passed which actually make it illegal to grow plant varieties not listed on an official register. More subtlely, the seed companies continue to promote their patented hybrid varieties as the traditional varieties are cast aside and ultimately lost forever. Again, Mr. Chairman, we cannot more strongly point out the effects this process will have on organic farming.

At the same time, Mr. Chairman, little is being done in this country to promote and protect those traditional varieties so important to the continued viability of organic farming.

While there are a number of seed storage facilities located throughout the world, they are chronically underfunded and understaffed. The National Seed Storage Laboratory in Fort Collins, Colorado, continues to limp along on meager funding. Its budget to go out and collect varieties before they become extinct is paltry. Activities by the United Nations, through its International Board for Plant Genetic Resources are likewise less than adequate.

In closing, Mr. Chairman, we appreciate once again the opportunity to express our comments to you on this important issue. We urge you and your colleagues to favorably consider S. 1128.

Sincerely,

BERNARD FENSTERWALD III,
Legislative Counsel.

STATEMENT OF DR. SAMUEL R. ALDRICH, PROFESSOR EMERITUS, SOIL FERTILITY AND EXTENSION, UNIVERSITY OF ILLINOIS

I am Samuel R. Aldrich, Professor Emeritus of Soil Fertility and Extension, University of Illinois, Champaign-Urbana, Illinois. I submit this statement as part of the record of the hearing in connection with S. 1128, the "Agricultural Productivity Act of 1983."

I was raised on a diversified crop/livestock farm in Michigan. We followed rather closely what is now called an organic system.

I received a B.S. degree in Farm Crops from Michigan State University and a Ph.D in Agronomy from Ohio State University. My experience includes positions at Ohio State University, Cornell University, and the University of Illinois.

In my work as an extension agronomist I have had occasion to evaluate organic farming repeatedly, most recently as chairman of a task force for the Council for Agricultural Science and Technology. I shall comment first on the scientific credibility of that task force. The task force, including 22 professors from relevant scientific disciplines in 13 universities plus two scientists from the U.S. Department of Agriculture, developed a report over a period of more than a year. This group was neither selected to produce nor coerced into producing a report favorable to either conventional or organic farming. The critics of the published report of which I am aware have been limited to a few persons who have little or no training in agricultural science and to a few persons who aruge that the report should have emphasized organic versus conventional food instead of the agricultural systems for producing such food.

Since the report was completed, I have continued to study and assess organic farming in comparison with conventional farming. Chapter 9 of my book, "Nitrogen in Relation to Food, Environment, and Energy" (1980), analyzes the two systems.

To some persons, organic farming appears to be a way to lower farm cost, to reduce the need for energy, and to minimize erosion. I shall comment on each of these seeming advantages.

Some of the "alternative" techniques described in Section 5(a)(1)(B) of S. 1128 are properly classified as a part of conventional farming because they are widely used.

Others that are more properly classified as alternative techniques are already available to farmers who have a moderate amount of experience in farming. There are no technical complications preventing their adoption. They have not been and are not now being widely adopted, not because of lack of information about them, but rather because it is widely know by farmers and the agricultural research/extension complex that they are not economically sound.

A shift from conventional toward organic production methods invariably involves a shift away from the most economically productive crops for the farm or region. The economic loss associated with this is inescapable.

The USDA team that prepared the 1980 "Report and Recommendations on Organic Farming" developed a budget analysis for a 340-acre (138-hectare) organic farm in the Midwest on which a seven-year cropping sequence of alfalfa (two years)-corn-soybeans-corn-soybeans-oats was practiced. Annual income above variable costs was $39,676. The income from a corn-soybean cropping system on the same farm was calculated to be $53,221—34 percent greater.

In a hypothetical analysis on 320 acres (130 hectares), a corn-soybean system produced 22 percent more income above variable costs than the best sequence that included crops to supply home-grown nitrogen.

The goal of reducing energy in agricultural production sounds good, but has little practical significance because the total used (even including the energy to produce the farm machinery) to deliver all crops and livestock to the farm gate is only 3 percent of the total U.S. use. Hence, even a 20 percent saving in energy used in crop production (highly unlikely) would result in less than a 0.6 percent reduction in energy use nationally. Furthermore, unless a decrease in the food supply is acceptable, any reduction in energy use claimed or foreseen is suspect because it does not take into account the extra energy required to farm additional acres in an attempt to make up the production that is lost on the present crop acreage. The so-called organic system described (but not named as such) in S. 1128 would cause a shortfall at least 20 percent in crop production. To offset that would require not 20 percent more acres but more nearly 30 percent because of the lower inherent productive capacity of the additional land that would have to be brought into production.

An expansion of 20 to 30 percent in cropland would defeat the goal of soil erosion control because much of the land would be so steep that erosion would occur even under an organic farming system. Moreover, an organic farming approach requires essentially the same intensity of cropping systems on all lands, irrespective of land use capability. Hence, when nearly level land that is least susceptible to erosion is underutilized in terms of its capacity to support intensive agriculture, other land more susceptible to erosion will be more intensively used.

The pilot research project described in S. 1128 could not achieve the stated goals because of design deficiencies likely described in the testimony of Dr. Holt and others. It would, however, produce misleading results, some favorable to systems based on optimal economic use of fertilizers, pesticides, et cetera, and some favorable to the system termed organic.

Robert Rodale, a leading proponent of organic farming, said (Tucker, 1979),

"Many people have the impression that we're advocating a wholesale switch to organic farming, but that is definitely not true. *We think that the arguments that organic farming can be done on a large scale are highly exaggerated and based on a very selective choice of facts (emphasis added).* Our methods of composting and cultivation are not suitable for large corporation farms, and probably couldn't be done on a large scale. We see our basic constituency as people who are in the homesteading and back-to-the-land movement."

It is often asserted that if as much research was directed to an organic approach as to conventional techniques, perhaps organic farms would become equally productive. That is not true because research deals mainly with new technology, whereas organic farming involves mainly the art of farming for which there are already available many years of relevant research and the experience of millions of others.

The only justification for proceeding with the proposed pilot research program would be to provide direct assistance to a small number of farmers who are outside the mainstream of agriculture, but who have little impact on the food supply of the United States.

I appreciate the opportunity to add these comments to the hearing record.

Statement of Carolina Farm Stewardship Association, Franklinville, N.C.

Carolina Farm Stewardship Assocation is a non-profit membership association of farmers, gardeners, businesses, and consumers who are concerned about agriculture

and the land. We are committed to ecological farming methods, the production of healthful food, and the preservation of the family farm. Formed in 1980, CFSA now has hundreds of members throughout North and South Carolina. Our principal activity is to provide an information and marketing network for alternative growers and conventional growers seeking to change their farming methods.

Carolina Farm Stewardship Association endorses the Agricultural Productivity Act (S. 1128). We urge the Senate to join the House of Representatives in passing this legislation so that our government can at least begin to use its resources to develop the new directions in agriculture that are so badly needed.

American agriculture can no longer afford to continue down the same energy-intensive, chemical-intensive, and land-destructive paths. The costs are too high: farmers going out of business, loss of topsoil and soil productivity, harmful chemcial residues in land, water, and food. Practices now in use may be profitable to a few individuals and companies, but they are jeopardizing our agricultural future. This legislation is an important step towards developing and encouraging agricultural systems that can not only be more productive and economical, but also be more ecologically sustainable.

Our organization is keenly aware of the paucity of research and extension being done on alternative systems and techniques. Our own resources are quite inadequate to serve the informational needs of our members and the many others who contact us for assistance. We applaud the few programs being undertaken, including some at our own North Carolina State University, but the effort is piecemeal, and is miniscule compared to the amount of research into other aspects of agriculture.

We feel that the objections of the U.S. Department of Agriculture to this legislation are hardly credible considering that the amount authorized by the bill in such a tiny proportion of the annual Agricultural Research budget and does not divert funds from any other projects. If the institution which would have the responsibility for carrying out this legislation has such small enthusiasm for it, we hope the Congress will exercise vigilantly its powers of oversight to insure that its wishes are fulfilled. And we know that there are many skilled and supportive individuals within USDA and at state and local levels who could do good work in this project.

Our agriculture has not developed in a vacuum. Government action, through Extension, through commodity programs, through tax laws, through conservation programs, has helped make American agriculture what it is today: hugely successful and dangerously flawed. The members of Carolina Farm Stewardship Association urge the Senate to give support to the development of a more sustainable agriculture by passing the Agricultural Productivity Act.

RURAL COALITION,
Washington, DC, June 29, 1984.

Senator JESSE HELMS, Chair
Committee on Agriculture, Nutrition and Forestry, U.S. Senate, Washington, DC.

DEAR SENATOR HELMS: The Rural Coalition is writing this in support of the Agricultural Productivity Act, S. 1128. The bill, although modest in scope and cost, makes necessary and long overdue additions to the research and extension efforts of the U.S. Department of Agriculture. Please include this letter as part of the official hearing record in this important legislation.

S. 1128, through the 12 pilot on-farm research programs it would create, would provide farmers with information about alternative agriculture practices that will result in reduced production costs and in the development of farming systems that conserve resources and enhance soil quality.

These are important concerns in this era of a chronically depressed farm economy and increasing alarm over the long term productivity of America's food producing resources. The need for new, cost-saving farm technology is obvious: while low commodity prices are a major cause of the acute economic distress in rural communities today, the rising cost of farming is also a prime culprit in farmers' economic problems. The price of all production costs rose an average 146 percent between 1972 and 1982, while prices for crops only rose 104 percent. In addition, productivity gains from new technologies have levelled off in recent years, so an increase in farm inputs no longer means an automatic increase in yields per acre. Thus, cost cutting farm technologies, like those that will be explored and refined through the research supported by this legislation, will play a critical role in keeping family farmers on the land and in encouraging new family farmers to enter agriculture.

The technologies and techniques suggested for study and practical application by S. 1128 will lead to better soil quality. Today, experts view with alarm the "mining" of America's top soil. On more than one-third of this nation's farmland, soil erosion

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rates exceed those considered tolerable. We are losing soil faster than it can be replaced by natural processes; loss of top soil will affect our long term ability to produce food and will lead to higher food production costs. Thus, research that improves soil conservation will serve not just farmers, but all Americans.

The 110 national, regional, state and local groups that make up the Rural Coalition urge the Senate Agriculture Committee to mark up S. 1128 as soon as possible so that this bill can come to the floor for a vote this year. We appreciate your efforts in this regard.

Sincerely,

CATHERINE LERZA,
Associate Director.

LAND STEWARDSHIP PROJECT,
St. Paul, MN, June 15, 1984.

Senator JESSE HELMS,
Chairman, Senate Committee on Agriculture, Nutrition and Forestry, Washington, DC.

DEAR SENATOR HELMS: I am director of the Land Stewardship Project, an ecumenical non-profit organization aimed at raising public awareness about the problems of soil erosion, farmland degradation and farmland loss to development. My staff and I have been following with interest the progress of the Agricultural Productivity Act (S. 1128). As you know, the measure was passed by the House of Representatives earlier this year and now awaits Senate action.

The Land Stewardship Project enthusiastically supports the House version of the bill, agreeing with Rep. Kika de la Garza that it may well be the most important piece of agricultural legislation this year. The bill would set aside about $2 million of USDA's annual research budget for each of the next five years for 12 on-farm studies on changing from energy-intensive to low-energy intensive farming practices. Under the legislation, an additional 12 farms chosen from across the nation which already have made the transition to more sustainable farming methods would be studied for five years. (I hope you will also do what you can to see that one of the farms is located in Minnesota. I know of a number of existing organic farms which would make ideal candidates for study.) The measure also would initiate a program to help farmers learn to use intercropping to control erosion with vegetative cover and direct USDA to make public existing Extension Service materials of use to farmers willing to farm organically. Since organic farming methods involve lower fossil fuel inputs and, in general, smaller units of production with an increased emphasis on careful husbandry, passage of the Agricultural Productivity Act represents a victory for both family farming and resource stewardship.

Over the past three years, I have attended dozens of meetings with farmers in high-erosion target counties throughout Minnesota and Iowa. At nearly every meeting farmers discussed organic farming as a possible means of cutting costs and conserving soil and water. At many meetings there were farmers who already had made the transition to regenerative farming methods and were pleased with the results. I also heard many complaints from farmers that they had trouble obtaining information from their local ASCS office when they were looking into alternative methods. I think it is safe to say that if the Extension Service does indeed have a good deal of information on the subject, as they apparently contend, it is not finding its way to the farmers on the land.

I would urge you, as Chairman of the Senate Agriculture Committee, to support this legislation and do what you can to move the measure through committee and on to the floor of the Senate for a vote.

Sincerely,

RON KROESE,
Project Director.

P.S. If possible, please add this letter to the hearing record on S. 1128.

98TH CONGRESS
1ST SESSION

S. 1128

Entitled the "Agricultural Productivity Act of 1983".

IN THE SENATE OF THE UNITED STATES

APRIL 21 (legislative day, APRIL 18), 1983

Mr. LEAHY (for himself, Mr. ANDREWS, Mr. BAUCUS, Mr. CHAFEE, Mr. CRANSTON, Mr. D'AMATO, Mr. HART, Mr. HAWKINS, Mr. HUDDLESTON, Mr. MITCHELL, Mr. SASSER, Mr. STAFFORD, and Mr. ZORINSKY) introduced the following bill; which was read twice and referred to the Committee on Agriculture, Nutrition, and Forestry

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A BILL

Entitled the "Agricultural Productivity Act of 1983".

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Agricultural Productivity Act of 1983".

FINDINGS

SEC. 2. The Congress finds that—

(1) highly productive agricultural systems which include sound conservation practices are essential to ensure long-term agricultural sustainability and profitability;

(2) agricultural research and technology transfer activities of the Department of Agriculture (including the Extension Service of the Department of Agriculture), cooperative extension services of the States, land-grant and other colleges, and State agricultural experiment stations have contributed greatly to innovation in agriculture, and have a continuing role to play in fostering more efficient and sustainable agricultural production systems;

(3) the annual irretrievable loss of billions of tons of precious topsoil through wind and water erosion reduces agricultural productivity and raises the spectre of another dust bowl;

(4) energy intensive agricultural practices are needlessly dependent on limited global reserves of oil and natural gas, heightening the economic vulnerability of the United States agricultural system;

(5) public funding of a properly planned and balanced agricultural research program is essential to improving agricultural productivity and conservation practices; and

(6) expanded agricultural research and extension efforts in certain key areas are needed to assist farmers in improving agricultural productivity and implementing soil, water, and energy conservation practices.

PURPOSES OF ACT

SEC. 3. It is the purpose of this Act to—

(1) facilitate and promote, within the context of modern agricultural technologies, the scientific investigation and understanding of farming systems with the potential to increase agricultural productivity without serious degradation of the land, reduce soil erosion and losses of water and plant nutrients, conserve energy and natural resources, and maintain high quantity and quality yields of agricultural commodities without relying on energy intensive agricultural practices; and

(2) provide assistance to family farmers and other producers to use such systems in a manner which is consistent with other provisions of law relating to family farms and which complements the use of modern agricultural technology in agricultural production.

INFORMATION STUDY

SEC. 4. (a) The Secretary shall inventory and classify by subject matter all studies, reports and other materials developed by the Secretary or by any person or government with the participation or financial assistance of the Department of Agriculture, which could be used to further the purposes of this Act.

(b) In carrying out such project, the Secretary shall—

(1) identify, assess, and classify existing information and research reports which will further the purposes of this Act, including, but not limited to, information and research relating to legume based crop rotations, the use of green manure, animal manures, and municipal wastes in agricultural production, soil acidity, liming in relation to nutrient release, intercropping, the role of organic matter in soil productivity and erosion control, the effect of topsoil loss on soil productivity, and nonchemical or biological methods of weed, disease, and insect control;

(2) identify existing information and research reports which are currently useful or require revision, and make these available to further the purposes of this Act; and

(3) identify gaps in the information available to the Extension Service for distribution to farmers and other members of the public in order to achieve the purposes of this Act, and establish a plan to carry out a program of research and education to fill those gaps.

PILOT RESEARCH PROJECTS

SEC. 5. (a)(1) The Secretary shall, pursuant to section 8 and with the cooperation of willing producers, conduct twelve pilot research projects on farms for the purpose of examining the effects of the transition from—

(A) farm practices which rely on synthetically compounded fertilizers, pesticides, growth regulators, livestock feed additives, and tillage practices which fail to control erosion; to

(B) farm systems which rely on legume and other sod based crop rotations, the efficient use of crop residues, green manures, animal manures, off-farm organic wastes and mineral bearing rocks, and the utilization of sound, efficient production practices including conservation tillage, conservation irrigation (including low pressure systems and irrigation scheduling), and nonchemical or biological methods of weed and pest control.

(2) The Secretary shall select farms on which to conduct the pilot research projects as follows:

(A) Six farms shall be selected which grow crops and raise livestock. Two of such farms shall be dairy farms and four of such farms shall be nondairy farms.

(B) Six farms shall be selected which grow crops but do not raise livestock. Four of such farms shall be farms that grow wheat, feed grains, upland cotton, or rice, or any combination thereof. Two of such farms shall be farms that grow fruits or vegetables, or both.

(b) In order to examine and assess the consequences of farm systems referred to in subsection (a)(1)(B) of this section, the Secretary shall also study twelve farms which have

been employing such farm systems for at least five years prior to the effective date of this Act. The Secretary shall select farms on which to conduct these pilot research projects on the same basis as described in subsection (a)(2) of this section.

(c)(1) Within one hundred and twenty days after the effective date of this Act, the Secretary shall select farms for participation in the pilot research projects required under this section with as diverse characteristics as practicable, including diversity in size, soil-type and climatic conditions.

(2) The pilot research projects shall be conducted pursuant to agreements which are entered into between the Secretary and producers operating the farms at which the pilot research projects are conducted and which provide that such farms shall serve as demonstration farms. The agreements may include limitations as to the hours during which the farms shall be open to the public for demonstration purposes.

(3) Each pilot research project shall extend for a five-year period.

(4) During the one-year period following the selection of pilot research project participants, comprehensive data concerning all aspects of the farming operations carried out on such farms shall be collected and analyzed in order to provide a baseline from which the effects of the project can be as-

sessed. Such data shall include, but not be limited to, information with respect to—

(A) the type, quantity, and cost of production inputs used in such farming operations, including capital, energy, fertilizers, pesticides, and water;

(B) the quality and quantity of production outputs of such farming operations, including information on crop yields, nutritional value of such crops, and rates of production in livestock operations;

(C) the characteristics of the soil of such farm, including the thickness of the topsoil on such farm, the rate of loss of such topsoil as a result of such farming operations, the level of organic nutrient matter in soil on such farm, the water holding capacity of such soil, and the rooting depth of plants in such soil;

(D) the characteristics of other natural resources of such farm including water quantity and quality;

(E) the net income derived from such farming operations; and

(F) such other factors as the Secretary deems appropriate to fully assess the effects of the project.

(5) During the last four years of such pilot research projects—

(A) in the case of farm selected under subsection (a)(1), the transition described in subsection (a) shall be

carried out as directed by the Secretary or the Secretary's designee.

(B) if a farm on which a pilot research project is conducted is located in a local conservation district, the owner or operator of the farm must have a conservation plan approved by and on file with the district. If such farm is not located in a local conservation district, the owner or operator of the farm must have a conservation plan approved by and on file with the Secretary; and

(C) data similar to the data collected in the first year of such pilot research project under paragraph (5) shall be collected and analyzed for all farms selected for participation in the pilot research projects in order to fully assess—

(i) the effects of the transition on the farms selected under subsection (a)(1); and

(ii) the efficiency of the operations on farms selected under subsection (b).

(6) The Secretary, in coordination with the Extension Service and the cooperative extension services of the States, shall take steps to ensure that farmers are aware of the existence of the demonstration farms.

(d)(1) The Secretary shall, subject to paragraph (2) of this subsection, make payments to producers who operate

farms selected under subsection (a)(1) at which the transition pilot research projects are conducted if the Secretary determines that such payments are justified to compensate farmers for any responsibilities assumed in order to carry out the projects agreed upon pursuant to this Act.

(2) Any payments so made by the Secretary—

(A) shall be made only during the last four years of such project; and

(B) in any such year, shall not exceed any difference between—

(i) the net income received by such producer with respect to farming operations carried out on such farm in the first year of such project, adjusted by the Secretary to compensate for any extraordinary economic condition, natural occurrence, or other situation which significantly affected net income from such operations in the first year of such project; and

(ii) the net income received by such producer with respect to farming operations carried out on such farm in the year for which payments are being made, adjusted by the Secretary to compensate for any extraordinary economic condition, natural occurrence, or other situation which significantly affected net income from such oper-

ations in the year for which payments are being made.

COORDINATION

SEC. 6. In order to fully effectuate the purposes of this Act, the Secretary shall take steps to ensure that the pilot research projects are designed and carried out in coordination with the Agricultural Research Service, Agricultural Stabilization and Conservation Service, Soil Conservation Service, Extension Service, cooperative extension services of the States, land-grant colleges and universities, State agricultural experiment stations, the National Association of Farmer Elected Committeemen, and the farmers participating in such projects.

REPORTS

SEC. 7. The Secretary shall submit to the Committee on Agriculture of the House of Representatives and the Committee on Agriculture, Nutrition, and Forestry of the Senate—

(1) not later than fifteen months after the effective date of this Act a report describing the results of the project carried out under section 4 of this Act;

(2) not later than April 1 of each of the calendar years 1985, 1986, 1987, and 1988, a report describing the progress of the pilot research projects; and

(3) not later than April 1, 1989, a report containing—

(A) a summary of the data collected under the pilot research projects;

(B) analyses of, and conclusions drawn from, such data; and

(C) recommendations for new basic or applied research from such conclusions.

AGREEMENTS

SEC. 8. (a)(1) The Secretary may carry out the project under section 4, conduct any pilot research project, and collect and analyze information developed under the pilot research projects through any agency in the Department of Agriculture or through agreements with any land-grant college and university or any other university or nonprofit organization which has demonstrated expertise in the areas of agricultural research and policy.

(2) The Secretary may not require matching funds for any such agreements.

DISSEMINATION OF DATA

SEC. 9. The Secretary shall make available through the Extension Service and the cooperative extension services of the States the information and research reports identified under section 4, the data collected under the pilot research projects, and analyses of, and conclusions drawn from, such

data, and shall otherwise take such steps as are necessary to assure that such material is made available to farmers and other members of the public.

INTERCROPPING ASSISTANCE

SEC. 10. Beginning on the effective date of this Act and ending five years after such date intercropping shall be considered an enduring conservation measure which is eligible for financial assistance under section 8(b) of the Soil Conservation and Domestic Allotment Act (16 U.S.C. 590h(b)).

DEFINITIONS

SEC. 11. For the purposes of this Act—

(1) the term "extension" shall have the meaning given to such term by section 1404(7) of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (7 U.S.C. 3103(7));

(2) the term "conservation plan" means a plan which describes and outlines a schedule for the implementation of conservation measures or practices on a farm which are designed—

(A) to prevent significant degradation of the soil, water, and other natural resources of such farm; and

(B) to meet the management objectives of the farmer operating such farm;

(3) the term "intercropping" means a crop production practice which involves establishing and cultivating a soil conserving crop (such as alfalfa, clover, trefoil, hairy vetch, grass, winter wheat, or oats) on land on which, at the same time, a row crop (such as corn, soybeans, or cotton) is established and cultivated;

(4) the term "land-grant colleges and universities" shall have the meaning given to such term by section 1404(10) of such Act (7 U.S.C. 3103(10));

(5) the term "demonstration farm" means a farm participating in a pilot research project conducted under section 5, which shall be open to the public in order to demonstrate the applicability of the farm systems being practiced on such farms;

(6) the term "Secretary" means the Secretary of Agriculture;

(7) the term "State agricultural experiment stations" shall have the meaning given to such term by section 1404(13) of such Act (7 U.S.C. 3103(13));

(8) the term "transition pilot research project" means the pilot research projects conducted pursuant to section 5(a) of this Act; and

(9) the term "United States" means the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mari-

ana Islands, and the territories and possessions of the United States.

AUTHORIZATION OF APPROPRIATIONS

SEC. 12. For purposes of carrying out this Act, there is authorized to be appropriated a sum not to exceed $2,100,000 for each of the fiscal years 1984, 1985, 1986, 1987, and 1988.

EFFECTIVE DATE

SEC. 13. This Act shall take effect October 1, 1983.

DATE DUE			

DATE DUE
